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Robert Peccia &
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Solid waste
systems analysis
study for Park
County

PARK COUNTY, MONTANA

AUGUST, 1980

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SOLID WASTE SYSTEMS ANALYSIS

Final Report

Robert Peccia & Associates
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ROBERT PECCIA & ASSOCIATES
Planners - Engineers - Designers
810 HIALEAH COURT
HELENA, MONTANA 59601 406/442-8160

August 28, 1980

Park County Refuse District
Park County Courthouse
Livingston, MT 59047

Re: Solid Waste Systems Analysis

District Members:

In accordance with our engineering agreement, we are transmitting fifteen (15) copies of the final Solid Waste Management Plan for Park County.

This study was funded through a grant from the State of Montana, Department of Health and Environmental Sciences. The primary purpose of this study was to inventory the current solid waste management practices in the county and to evaluate various alternate waste handling alternatives to effectively and economically dispose of the wastes generated within the county. Included in Part Six of this report is a summary of the investigations conducted for the project as well as the resultant recommendations.

We appreciate the opportunity to conduct this study for your county and feel this project would not have been a success without the hard work and input from the members of the technical committee that organized and oversaw this project. If you desire additional information, or if we can be of further assistance to your district in implementing this plan, please contact us at your earliest convenience.

Respectfully submitted,

ROBERT PECCIA & ASSOCIATES

Barry E. Damschen

Barry E. Damschen, P.E.
Vice-President

BD/gp

SOLID WASTE SYSTEMS ANALYSIS STUDY

FOR

PARK COUNTY

AUGUST, 1980

FINAL REPORT

Prepared By:

Robert Peccia & Associates

The funding of this project was made possible through a grant obtained from the State of Montana Department of Health and Environmental Sciences.

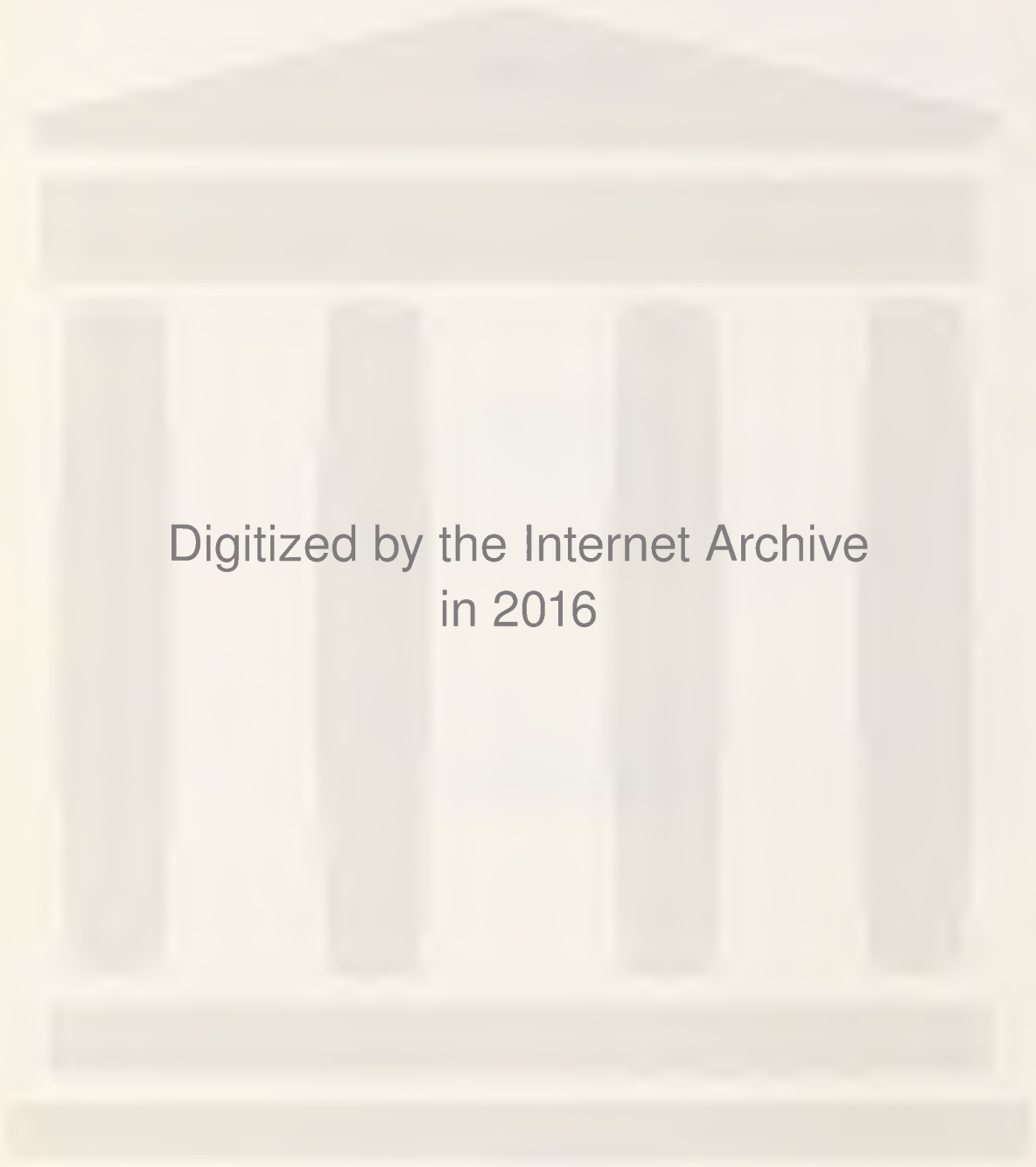

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TABLE OF CONTENTS

PART ONE: INTRODUCTION

- A. Background
- B. Project Scope of Work

PART TWO: EXISTING SOLID WASTE MANAGEMENT CONDITIONS

- A. General
- B. Applicable Laws & Regulations
- C. Existing Solid Waste Services and Facilities
- D. Solid Waste Quantities

PART THREE: RECYCLING FEASIBILITY ANALYSIS

- A. General
- B. Types and Quantities of Recoverable Materials
- C. Market Analysis for Secondary Materials
- D. Summary of Recycling Feasibility

PART FOUR: EVALUATION OF ALTERNATIVE DISPOSAL SYSTEMS

- A. General
- B. Description of Applicable Alternatives
- C. Annual System Cost Analysis

PART FIVE: ANALYSIS OF SPECIAL WASTES

- A. General
- B. Analysis of Individual Waste Types

PART SIX: SUMMARY AND RECOMMENDATIONS

- A. Project Summary
- B. Recommendations

APPENDIX A: SUMMARY OF WASTE DISPOSAL DATA

LIST OF TABLES

Table No.	Description	Following Page
1	Solid Waste Quantities	2.12
2	Waste Generation Rate Analysis	2.14
3	Projected Solid Waste Quantities	2.14
4	Solid Waste Breakdown	2.16
5	Solid Waste Composition	3.2
6	Ferrous Material Markets	3.4
7	Non-Ferrous Material Markets	3.7
8	Glass Markets	3.7
9	Newsprint Markets	3.9
10	Corrugated and Mixed Paper Markets	3.10
11	Current Landfill Cost	4.4
12	Baling Facility Costs (Short Haul)	4.6
13	Baling Facility Costs (Long Haul)	4.6
14	Balefill Landfill Cost	4.7
15	Compacted Transfer Station Cost	4.8
16	Class III Landfill Cost	4.8
17	Non-Compacted Transfer Station Costs	4.9
18	Conventional Landfill Costs with Transfer	4.10
19	Waste Incineration Costs	4.16
20	Transportation Unit Costs	4.18
21	Alternatives System Cost Analysis Summary	4.19
22	Transportation Cost Summary	4.19
A-1	Park County Disposal Records	Appendix A

LIST OF FIGURES

Figure No.	Description	Following Page
1	Waste Generation Fluctuation	2.12
2	Park County Population Projection	2.13
3	Livingston Population Projection	2.13
4	Landfill Vehicle Source Summary	4.3
5	Baling Facility with Short Haul	4.6
6	Baling Facility with Long Haul	4.6
7	Transfer Station with Compaction	4.8
8	Transfer Station without Compaction	4.9
9	Incineration Facility	4.13
10	Available Energy from Solid Waste	4.15

PART ONE

INTRODUCTION

PART ONE

INTRODUCTION

A. BACKGROUND

In the fall of 1976 the County Commissioners of Park County created a County Refuse Disposal District for the purpose of administering and financing the operation of a solid waste disposal system for the county. The system that is currently in operation consists of a central landfill located five miles east of Livingston and a rural container system consisting of 175 four-cubic-yard containers located throughout the county. The wastes deposited in the containers are transferred to and finally disposed of at the county landfill by use of a front-loading packer vehicle.

Due to the high winds that are common in the Livingston area, it became quite evident to the County governing board in 1978 that the operation of the district landfill within acceptable local and state litter regulations and requirements would be difficult. Several efforts subsequently were made by the Refuse Board to operate the site without creating undue litter problems to adjacent properties. After exhausting all possible operating procedures, the Refuse Board of Directors determined the need to evaluate alternate waste disposal methods to possibly replace the current district sanitary landfill.

In April, 1979 the Park County Refuse Disposal District Board of Directors retained the consulting firm of Robert Peccia & Associates to evaluate possible alternatives to the use of the existing district landfill. To fund the study, the Park County Board of Commissioners applied for a grant from the State of Montana Department of Health and Environmental Sciences. Grant monies were subsequently obtained in July, 1979, with the project initially begun in August of that year.

B. PROJECT SCOPE OF WORK

Initially a detailed scope of work was developed by the County Refuse Board and the consultant. The work elements determined applicable were developed such that recommendations could be formulated in an orderly sequence for the proper disposal of solid waste. Included herein is a summary of the work elements that were completed for this project.

1. Identification and evaluation of current solid waste management conditions in Park County, including solid waste storage, collection, transfer and disposal operations and facilities, and waste generation and composition characteristics.

2. Evaluation of the feasibility of recycling all or portions of the secondary materials generated within the county.

3. Evaluation of alternate solid waste transfer, incineration and disposal systems with specific emphasis placed on the practicability and costs of specific alternates to update or replace the current district landfill located near Livingston.

4. Evaluation of current problems and possible alternate solutions for "special" type wastes including tires, demolition debris, used pesticides and containers, used oils, septic tank pumpings, and sludges.

5. Formulation of a summary of the various alternatives evaluated with specific emphasis placed on the advantages and disadvantages of each potentially applicable system.

6. Preparation of a report that summarizes all findings, conclusions and recommendations of the project.

7. Development of a public participation and involvement program for effectively informing the Refuse District Board members and the public of the findings of the project and for obtaining comment and public input.

PART TWO

EXISTING SOLID WASTE MANAGEMENT CONDITIONS

PART TWO

EXISTING SOLID WASTE MANAGEMENT CONDITIONS

A. GENERAL

When evaluating the existing solid waste management situation in a specific area, there are three major aspects that must be addressed: 1) the current laws and regulations which regulate the various phases of solid waste management; 2) the effectiveness of existing solid waste storage, collection and transportation services and the adequacy of the existing disposal facilities, and 3) the quantities and characteristics of the solid waste generated. Included in the following narrative is a brief summary of these major aspects as they relate to this project.

Obviously, there are several other aspects that are directly related to the total solid waste management system in the area. These include: 1) the recovery and recycling of solid waste; 2) the disposal of special and hazardous type wastes; and 3) the economic, organizational and financial aspects of the existing and proposed programs and systems. In the interests of greater clarity and better organization of this report, these aspects will be discussed in subsequent chapters.

B. APPLICABLE LAWS AND REGULATIONS

There are basically three degrees of laws and regulations which directly affect the management of solid waste in the county. These include: 1) local ordinances; 2) State of Montana Disposal Laws and Rules; and 3) Federal Laws and Regulations. Included in the following text is a brief discussion of the various laws and regulations which directly affect the management of solid waste in Park County.

1. Local Ordinances

Park County, through the Park County Refuse Disposal District, adopted in 1976 a refuse fee schedule and user regulations for the proper use and administration of the Refuse Disposal District's facilities. Also, the City of Livingston has adopted a local ordinance which requires solid waste to be properly disposed of. This ordinance primarily deals with local conditions such as the solid waste collection and disposal procedures and current rates.

2. State of Montana Laws and Regulations

The Laws and rules set forth by the State of Montana Department of Health and Environmental Sciences are the principal regulations in the study area which must be adhered to. The State laws concerning solid waste management were initially adopted by the 1965 State Legislature. Since that time the regulations have been amended three times. The laws and regulations set forth by the State of Montana include legal and administrative control over all phases of solid waste management including the following: (1) facility licensing, (2) standards for the operation and maintenance of facilities, (3) facility classification, (4) solid waste transportation and disposal of hazardous wastes, (5) litter control, (6) disposal of dead animals, (7) feeding garbage to animals, (8) nuisances and (9) disposal of junk vehicles.

Included in the following narrative is a brief summary of the principal rules and regulations which are included in the State Solid Waste Management Act as amended in 1977. A copy of the complete rules and regulations can be obtained from the State Department of Health and Environmental Sciences, Solid Waste Management Bureau.

(a) Disposal Site Licenses

Under the present state laws, all sanitary landfill sites must be licensed by the State Department of Health and Environmental Sciences, Solid Waste Management Bureau. The Department has established three classifications for refuse disposal sites. A summary of the three classifications are included below:

(1) Class I

Class I sites may accept all groups of waste including hazardous wastes. Class I sites shall not discharge these materials or their by-products to ground or surface waters. These sites must either confine the wastes to the disposal site with no likelihood that the wastes will escape or they must be situated in a location where the leachate from the wastes can only percolate into underlying formations which have no hydraulic continuity with usable waters.

(2) Class II

Class II sites are suitable for accepting decomposable and organic materials, wood and demolition materials, and digested wastewater sludges. The site must provide for separation of these type materials from underlying or adjacent usable water. The distance of the required separation is established on a case-by-case basis, considering factors such as terrain, type of underlying soil formations, and natural quality of the groundwater.

(3) Class III

Class III sites are suitable for accepting only inert type materials excluding potentially hazardous wastes. The site may contain water such as in marshy areas which contain exposed groundwater, or areas which may be periodically flooded, such as along stream flood plains. Class III sites shall not be located on the banks or in a live or ephemeral stream.

The department may issue a conditional license for solid waste management systems already in existence or under construction on the effective date of this rule. Such a license if granted will be valid for up to one year. Only when the department determines that the conditional licensee has shown good cause for an extension will one be granted. Conditional licenses are to be granted only if the applicant demonstrates steps are being taken to bring the site into compliance. The local health officer must validate all conditional licenses before they are effective.

The department may deny or revoke a license to operate a solid waste management system after giving the applicant and the local health officer written notice and an opportunity for a hearing before the board. The decision to deny or revoke a license may be made only after finding that a solid waste management system cannot be operated or is not being operated in compliance with the state laws and regulations. The hearing held before the board on a denial or revocation shall be held pursuant to the provisions of the Montana Administrative Procedure Act.

(b) Disposal Site Operation and Maintenance Requirements

(1) Class I sites

Due to the hazardous nature of the waste that may be processed at these sites, strict supervision is required when such sites are open. Sites shall be fenced

to prevent unauthorized access. All Class I sites using landfilling methods shall cover Group I wastes with a minimum of twelve (12) inches of suitable earth cover material after each operating day and at least four (4) feet of earth cover material within one week after the final deposit of solid waste. These steps must be taken unless the department is satisfied that the licensee has shown good cause for not covering.

Where other solid waste management methods are proposed to dispose of Group I wastes, the operation and maintenance plan must demonstrate to the department's satisfaction that such disposal methods pose no danger to man and the environment. Group II wastes disposed at Class I sites shall satisfy all Class II disposal requirements.

(2) Class II Sites

All Class II sites using landfilling methods shall compact and cover solid waste with a layer of at least six (6) inches of approved earth cover material at the end of each operating day and at least two (2) feet of approved earth cover material within one week after the final deposit of solid waste at any portion of the site. These steps must be taken unless the department is satisfied that the licensee has shown good cause for not covering.

EPA's 1972 publication, "Sanitary Landfill Design and Operation," (No. SW-65ts) shall be used as the general landfill design and operation manual for purposes of this rule. The department may develop or adopt guidelines for other solid waste disposal methods and procedures. Semisolids should be mixed with other solid waste to prevent localized leaching; or separate, specialized disposal areas should be developed. Sites shall be fenced to prevent unauthorized access and shall be supervised when open.

Where refuse containers are utilized as part of a management system for Group II solid wastes, all containers shall be maintained and kept in a sanitary manner and emptied at least once a week unless other arrangements are determined acceptable.

(3) Class III Sites

Although these sites are not required to be covered by earth materials daily, they shall be covered periodically.

(4) Open Burning

For all classes of sites the open burning of wastes is prohibited unless a variance has been obtained from the department.

(5) Litter Control

Dumping must be confined to the areas within the disposal site that can be effectively maintained. Also, effective means shall be taken to control litter at all facilities.

(c) Hazardous Waste Management Systems

(1) The department may require the maintainance of records, including copies of waste manifests, and the submission of reports from persons who store, treat, or dispose of hazardous wastes. Permanent records must be maintained by the operator of hazardous waste disposal facility, identifying the location of each disposal area and wastes or waste types disposed. Such disposal records shall be made available to the new facility owner or operator if the facility is sold or leased to another person.

(2) No hazardous waste management system may store, treat, or dispose of hazardous wastes in a manner which is inconsistent with methods approved by the department.

(3) All hazardous waste management systems are required to have licenses issued by the department.

(4) Hazardous wastes found in household refuse may not be disposed of at Class II disposal sites without written authorization from the department.

(5) For areas not served by licensed Class I disposal sites, the department may, upon showing of good cause, authorize the disposal of hazardous wastes at Class II disposal sites if no health hazard or no danger to the environment would be presented.

(d) Inspection and Enforcement

The department has authority to conduct inspections of solid waste management systems at reasonable hours upon presentation of appropriate credentials. If, after an

inspection, the department determines that violation of the act or this rule is occurring, it shall notify the licensee of the nature of the violation. Depending on the severity of the violation(s), the department may seek a compliance schedule from the applicant or initiate proceedings to revoke the license. The department may also, through the attorney general or appropriate county attorney, seek to enjoin the licensee or collect a criminal penalty.

(e) Loans and Grants

(1) The department shall provide financial assistance to local governments for front-end planning activities for a proposed solid waste management system which is compatible with the state plan whenever such financial assistance is available.

(2) The department shall provide front-end organizational loans for the implementation of an approved solid waste management system whenever funds for such loans are available.

(f) Refuse Disposal Districts

The state laws give the county commissioners the authority to create solid waste districts for the purpose of collection and/or disposal of refuse. Cities and towns may be included in the district if approved by the city or town councils.

(g) Dead Animals

It it unlawful to place all or part of a dead animal in a lake, river, creek, pond, reservoir, road, street, alley, lot or field. Also, it is unlawful to place a dead animal within one mile of the residence of any person unless the dead animal is burned or buried at least two feet underground.

If a person refuses or neglects to comply with a written order of a state or local health officer within a reasonable time specified in the order, the state or local health officer may cause the order to be complied with and initiate an action to recover any expenses incurred from the person who refused or neglected to comply with the order. The action to recover expenses shall be brought in the name of the city or county. A person who does not comply with rules adopted by the board will be guilty of a misdemeanor.

(h) On-Site Disposal

The state solid waste laws do not prohibit individuals or industry from disposing of solid wastes on his or her own property as long as such disposal does not create a nuisance or health hazard. A nuisance is defined as "anything which is injurious to health or is indecent or offensive to the senses, or an obstruction to the free use of property, so as to interfere with the comfortable enjoyment of life or property, or unlawfully obstructs the free passage or use, in the customary manner, of any navigable lake, or river, bay, stream, canal, or basin, or any public park, square, street, or highway."

(i) Motor Vehicle Wrecking Facility Act

Under this act, each county is to establish a county motor vehicle graveyard where any citizen places a junk vehicle free of charge. The county is also responsible to establish a collection program in order to pick up the junk vehicles and place them in the graveyard facility. Other provisions of the law call for licensing and shielding all private motor vehicle wrecking facilities and county motor vehicle graveyards.

(j) Penalty for Violations

(1) Any person violating the act or regulations prescribed by the Department under the act, shall be guilty of a misdemeanor and, upon conviction, shall be fined not less than $50 nor more than $500. Each day upon which a violation of this act occurs shall be considered a separate offense.

(2) A person who stores, treats, transports, or disposes of a hazardous waste in viloation of this chapter, a rule adopted as authorized by this chapter, or an order issued as provided in this chapter is subject to a civil penalty of not more than $25,000. Each day upon which a violation occurs is a separate violation.

3. Federal Regulations

The federal regulations concerning the proper management of solid waste is included in the "Resource Conservation and Recovery Act of 1976" (RCRA) which is documented as Public Law 94-580. The primary purpose of the law is to suggest guidelines for the proper disposal of solid and hazardous wastes generated in the nation and to also develop guidelines for the proper and safe recovery and reuse of recyclable materials found in the solid waste system.

One primary feature of RCRA is the method by which the new federal act is to be administered by the individual state governments through the assistance of the Environmental Protection Agency. Based on this premise, the State of Montana amended its laws and rules in 1977 to be in conformance with the new federal guidelines. Therefore, the State of Montana's laws and rules coincide quite closely with the new federal standards regarding solid waste management.

C. EXISTING SOLID WASTE SERVICES AND FACILITIES

For this study several sources of information concerning the existing solid waste management practices in the county were identified. The primary sources that were utilized include: 1) interviews and discussions with local, state and federal officials directly responsible for the regulation and administration of the solid waste systems in the county; 2) discussions with local officials and private citizens directly responsible for the operation and/or management of solid waste collection, transfer or disposal services and facilities; 3) on-site inspections by the consultant of all facilities and equipment pertinent to the management of solid waste; and 4) review of current and past reports and materials which have evaluated the existing systems and facilities. Included herein is a summary of the existing solid waste related services and facilities available in the county.

1. Collection

Currently there are three door-to-door collection services available in the county. Two of the services are privately operated, and the third is municipally operated. Included in the following narrative is a brief description of each service.

(a) City of Livingston

The City of Livingston offers a municipally operated collection service to its residents. At the present time the collection service operates once per week for residential units and one to five times per week for commercial establishments, depending upon the amount of refuse generated. The garbage collection rates for residential units are $59 per year. The rates for commercial establishments vary, depending upon the number of stops made and the quantity of waste collected. The city utilizes two 17-cubic-yard rear-loading packer trucks for garbage collection. A three-man crew is utilized for residential routes, and a two-man crew is utilized for commercial pickups. The wastes collected are transported to the Park County Sanitary Landfill.

(b) Private Services

There are two private collection services available to residents in the county. One service is owned and operated by Mr. Hillman. He utilizes a 12-cubic-yard rear-loading

packer truck and primarily collects wastes from residential and commercial units located along U.S. 89 south of Livingston, and on the outskirts of the city. Mr. Hillman disposes of the wastes he collects at the Park County Landfill.

The second private collection service available in the county is owned and operated by Mr. Logan. He primarily collects wastes in the Clyde Park area. The collection service provided by Mr. Logan basically includes once per week service with all wastes transported to and disposed of at the Clyde Park Landfill.

2. Existing Disposal Facilities

(a) Refuse Disposal District Facilities

In 1977 the Park County Commissioners created a Refuse Disposal District for the expressed purpose of effectively disposing of the waste generated in the county. The District encompasses all portions of Park County with the exception of the incorporated communities of Livingston and Clyde Park. Currently, all residents included in the District are assessed an annual fee of $12 per household. In addition, each commercial establishment is assessed a fee of $12 or more, depending upon the quantity of waste generated.

Currently the County Refuse District operates a centrally located landfill near Livingston and a rural container system for use by the individual district members. Included herein is a brief description of these disposal facilities.

(1) Refuse District Landfill

The Refuse Disposal District landfill is located approximately five miles east of Livingston on county-owned property. The site was licensed and opened in November of 1977. The site is open five days per week during the winter months, five and one-half days per week during the spring and fall months, and six days per week during the summer months. During the operational hours of the landfill there are usually two employees present; an equipment operator and a laborer. Records are kept of all vehicles that enter the site. Information recorded includes estimated waste quantities, general waste type and sources of waste generation. To maintain the site, the Refuse District recently purchased a used 977 dozer. The dozer is used primarily to compact the waste and apply daily soil cover. The district also retains a local individual to periodically excavate trenches at the site. Currently, all members of the County Refuse District are allowed free dumping privileges, and non-members are assessed a gate fee based on a sliding scale depending on the type(s) and quantities of waste

delivered. The 1979-1980 operating budget for the landfill site is approximately $126,000.

Since the landfill site opened in 1977, the local officials responsible for the site's operation have been plagued by high winds and consequent blowing paper and litter problems. In an attempt to solve this problem, the operating personnel at the landfill have attempted several corrective measures including deepening trenches, altering directions of trenches, constructing expensive litter control fences and applying excessive quantities of cover material. Because of the abnormally high winds that occur on a regular basis, all corrective measures to reduce the litter problem have basically failed. Based on this premise, the county officials were forced to look for alternate disposal sites or methods.

(2) Rural Container System

In conjunction with the landfill, the Refuse District owns and operates a rural container system for use by the district members who live an excessive distance from the centrally located district landfill. The container system is comprised of 175 four-cubic-yard metal containers. The containers are strategically located throughout the county. Each container is emptied at least twice per week, with many emptied three times per week during the summer months by use of a 32-cubic-yard front-loading packer truck. The packer truck is operated by one full-time employee, who travels approximately 30,000 miles annually. The wastes collected by the rural container system are disposed of at the district landfill located near Livingston. The annual operating budget of the container system is approximately $41,000.

(b) Disposal of Other Wastes

As previously discussed, the incorporated communities of Clyde Park and Livingston are not members of the countywide refuse disposal district. Since the formation of the county refuse district, the City of Livingston has, however, paid the district a lump sum amount for use of the district landfill. Currently the City of Livingston and the Refuse District officials are negotiating the fee for the City's use of the District landfill for this fiscal year.

Although Yellowstone National Park is not located in Park County to any significant degree, for the past several years the National Park Service has been transporting and disposing of a majority of the wastes generated within the Park to the Park County Refuse Disposal District landfill located near Livingston. Each year, representatives of

the Park Service and the Refuse Disposal District negotiate a fee for the use of the landfill to dispose of the wastes generated in the northern and southern districts of Yellowstone Park. The Park Service utilizes 75-cubic-yard transfer trailers to transport the waste to the district landfill. The transfer trailers are individually loaded with waste utilizing transfer stations located near Mammoth and Lake.

D. SOLID WASTE QUANTITIES

1. General

An important and useful tool in the evaluation and design of any existing or proposed solid waste system and facility is the solid waste generation within the specific service area of the proposed facilities. If the quantities of solid waste generated in the past have been recorded, present and future quantities of waste can reasonably be projected.

From the Consultant's experience and from studies completed by various governmental groups, it has been determined that waste generation per capita varies with population density. Large urban areas have a higher generation rate per capita because of the industrial and commercial wastes present. Rural areas with little or no commercial-industrial activity generate relatively small amounts of refuse. Such solid wastes usually consist of only household wastes. Small towns generally have some commercial wastes, but have very little industrial wastes. An analysis of the waste generation information that was compiled for this project as well as for previous solid waste-related projects in the state illustrates this point very well. Summarized in the following text is a brief description of the waste generation data that was determined applicable for Park County.

2. Existing Waste Quantities

Currently, with the exception of the small volume of waste generated in the Clyde Park area, all wastes generated in the county are transported to and disposed of at the Park County landfill located near Livingston. Based on this, a detailed evaluation of the wastes entering this landfill essentially indicates the quantities of wastes generated by each individual jurisdictional entity within the service area of the landfill.

To determine the quantities of waste being disposed of at the Park County landfill, all pertinent waste disposal records kept at the site were reviewed. Since the landfill was opened in 1977, information relative to each vehicle's origin, waste volume and general waste composition has been recorded. Since the Park County landfill is not equipped with scales, the information recorded by the landfill personnel for each vehicle is according to volume rather than weight.

Based on the availability of disposal records, the Consultant conducted a detailed analysis of the waste disposal records for the past one-year period (August, 1978 to July, 1979). After a thorough review of the records it was determined that all wastes brought to the landfill are classified into one of seven generation source categories. Thus, for the one-year period in which the records were reviewed, the volumes of waste for each of the seven waste generation categories were summarized and itemized by month. The volumes of waste recorded from this analysis are summarized in Table A-1, which is located in Appendix A. This information is further summarized in Table 1. As indicated in Table 1, the total "as-received" volume of waste delivered to the Park County landfill during the one-year period from August, 1978 through July, 1979 was approximately 65,698 cubic yards.

To obtain an accurate measure of the solid waste being brought to the Park County landfill, it was necessary to convert the volumetric waste estimates summarized above to tonnage estimates. The primary reason for this was due to the wide variation in the densities of the wastes delivered by the site. For example, waste delived by garbage packer trucks is two to four times denser per cubic yard than waste delivered by individuals, due to the compaction obtained by the packer truck.

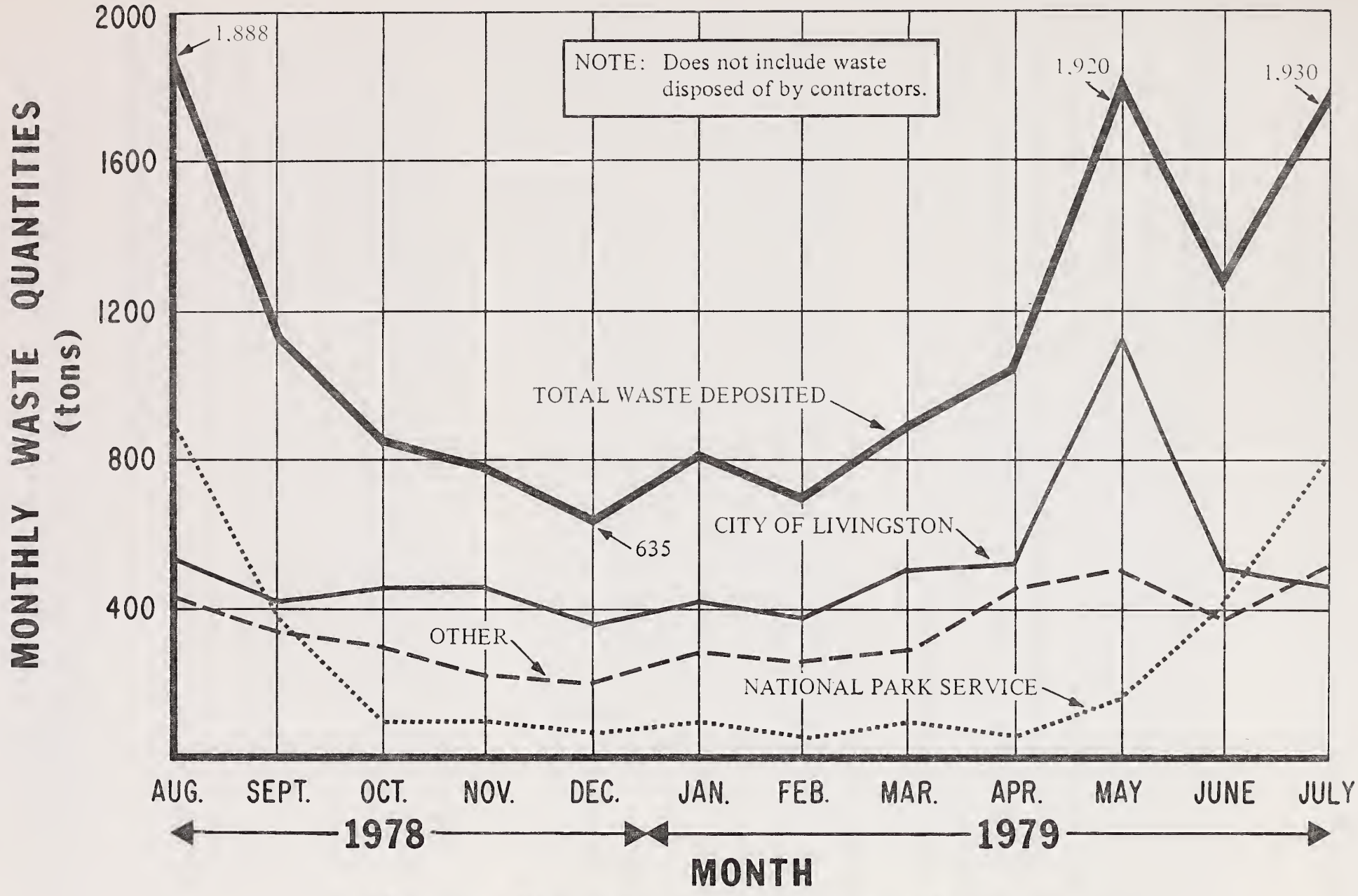
To obtain the estimated quantity of waste by weight delivered to the site, it was necessary to multiply the volume of waste by individual density factors. The density factors utilized for this conversion for each of the seven generation sources were determined by obtaining average density information for various types of vehicles from landfills where all wastes are weighed. Also, several of the City of Livingston and Park County packer trucks were periodically weighed during the study to obtain average density information for those vehicles. Based on this information, the quantities of waste by weight were estimated by month for each of the seven waste generation sources. The densities utilized as well as the monthly calculations are summarized in Table A-1, located in Appendix A. The total waste generated for the one-year period is summarized by waste generation source in Table 1. As indicated in the table, it is estimated that approximately 14,408 tons of waste are delivered to the Park County landfill annually. As also indicated in the table, the major waste generators are the City of Livingston, Park County and Yellowstone National Park, respectively.

An indication of the seasonal variation of the waste generation in the area was also evaluated. This seasonal variation is depicted in Figure 1. As indicated in the figure, the total waste brought to the landfill varies significantly from a high of 1,930 tons during the month of July to a low of 635 tons during the month of December. This represents a 300 percent variance from summer to winter. A major factor in this wide seasonal variation is the extremely high volume of waste brought to the landfill site by the Yellowstone Park Service in the summer,

TABLE 1

PARK COUNTY LANDFILL
SOLID WASTE QUANTITY BREAKDOWNS
(August, 1978 - July, 1979)

Generation Source	As-Received Volume (Cubic Yards)	Estimated Waste Quantity	
		Total Tonnage	Percent Of Total
1. City of Livingston	24,330	5,778	40.1
2. Park County	14,766	3,507	24.3
3. Hillman	1,776	377	2.6
4. Individuals	5,484	411	2.9
5. Burlington Northern	3,687	277	1.9
6. National Park Service	13,563	3,221	22.4
7. Private Contractors	2,092	837	5.8
TOTALS –	65,698	14,408	100.0



Park County Landfill Summary

Figure 1

whereas the Park Service generates very little waste during the non-tourist winter months. This seasonal variation is quite significant when designing solid waste disposal facilities, since any facility must be designed to handle the anticipated peak daily quantity.

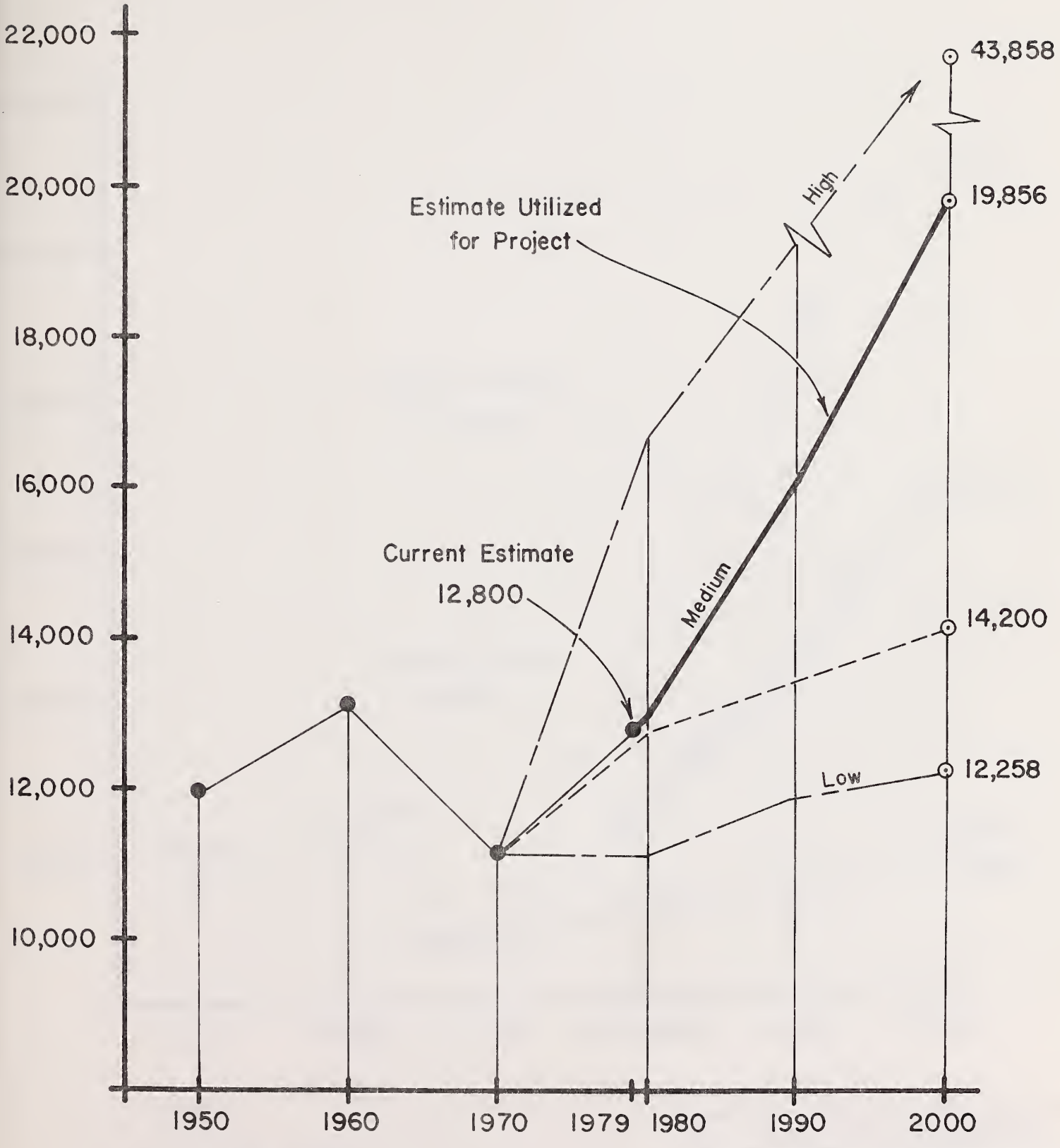
3. Projected Waste Quantities

In order to project future quantities of waste generated in the service area of the Park County landfill, it was attempted to identify the per capita waste generation in the area. By calculating current average waste generation rates, future waste quantities could be projected by multiplying the estimated current waste generation rates by the projected population of the service area for the foreseeable future. In addition to projected waste quantities, the calculated current average per capita waste generation rates in the county could be utilized for comparison with known waste generation rates in other areas of Montana to determine if the quantities of waste that have been estimated for this study are reasonable and accurate.

To calculate the per capita waste generation rates for Park County, it was initially necessary to obtain estimated current populations for the area. Because waste generation rates typically vary substantially between city residents and rural residents (primarily due to the commercial - industrial activity in the larger cities), it was attempted to separately identify the City of Livingston population and the population in the remainder of the county. In order to best identify the current and projected populations for these two major jurisdictions, population information from several sources were obtained and evaluated. Information obtained included past census data, local planning studies and input from local officials, and data obtained from the Montana Department of Community Affairs, Division of Research and Information Systems (DCA).

Upon review of the population information compiled, it was determined that the population information generated by the DCA was most accurate and acceptable. The DCA basically has two sources of population data available. The sources projected populations for Park County and all incorporated communities within the county. The two DCA projection sources were released consecutively in 1977 and 1978. Unlike the population released in 1978 where only one projection was made, the 1977 publication includes three population projections ranging from low to high. In all cases, the projections were made based on a mathematical model and assumptions concerning the future trends of the three major factors affecting population: births, deaths and migration.

The population information compiled by DCA for Park County and the City of Livingston is summarized in Figure 2 and 3, respectively. As depicted in the figures, the existing and



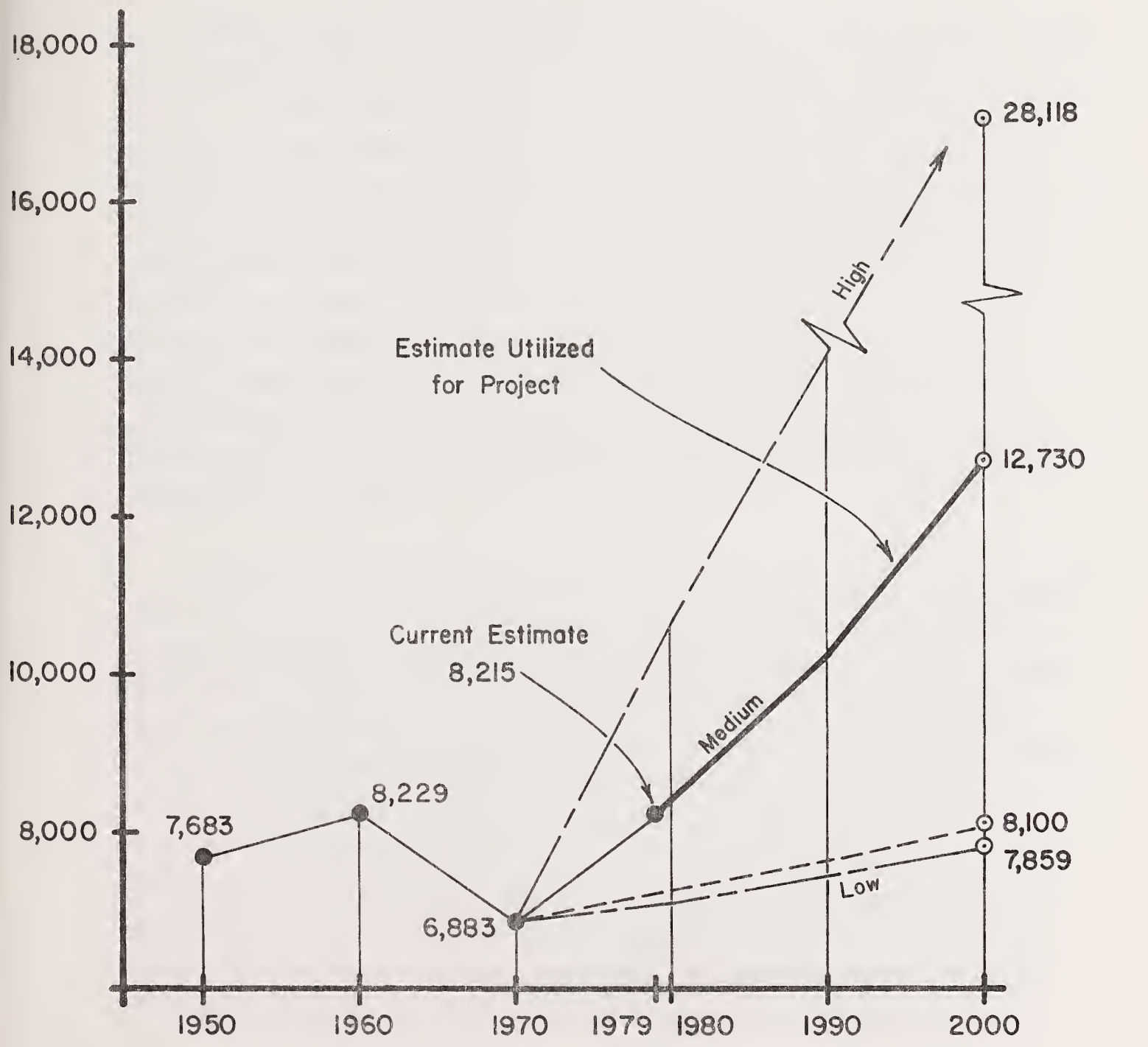
LEGEND

- U.S. Census
- 1977 DCA Projections
- 1978 " "
- Robert Peccia & Associates Projection

PARK COUNTY

POPULATION PROJECTIONS

Figure 2



LEGEND

——— U.S. Census

— — — 1977 DCA Projections

- - - - 1978 " "

——— Robert Peccia & Associates Projection

CITY OF LIVINGSTON

POPULATION PROJECTIONS

Figure 3

projected populations of the two jurisdictions vary considerably from one estimate to another. Based on the input obtained from the local officials, it was determined that the most accurate projections at this time are the "medium" DCA projections made in 1977. Therefore, for this study those population projections were used to calculate current waste generation rates and to project future waste quantities in the county.

Based on the waste quantities depicted in Table 1 and the population estimates included in Figures 2 and 3, the estimated current per capita waste generation rates for the residents in the City of Livingston and the remainder of Park County were calculated. As depicted in Table 2, the wastes included in the City of Livingston, Burlington Northern, individual contractors and the individual hauler generation source categories were included and subsequently divided by the City of Livingston's population to obtain the City of Livingston's average waste generation rate. In regard to the waste generation rate that was calculated for the remainder of the county, the wastes collected by the county district crews as well as the waste collected by Mr. Hillman were included. It should be noted, however, that since the community of Clyde Park does not utilize the Park County landfill, the estimated population of that community was not included when the waste generation rate for the county residents was calculated. Also, it should be noted that the wastes generated in Yellowstone Park were excluded from this analysis.

As depicted in Table 2, the average waste generation rates for the City of Livingston and Park County are 4.37 and 4.91 pounds per capita per day, respectively. When comparing the City of Livingston's generation rates with other communities' generation rates, it appears that the rate calculated herein is quite reasonable and comparable to other communities in the state with approximately the same population. On the other hand, when the Park County per capita generation rate of 4.91 pounds is compared to other rural areas' generation rates, it appears that this rate is substantially higher than average. A typical rural waste generation rate in Montana normally varies from 2.25 to 3.25 pounds per person per day. After thoroughly reviewing these comparative rates with local and state officials, it became apparent that the higher local generation rate is primarily due to the substantially higher than average number of summer homes and tourist-related wastes. Taking these factors into account, it is reasonable to expect that the generation rate calculated herein is quite logical and accurate.

Based on the population projections and average waste generation rates estimated herein, it was possible to project the future quantities that may be generated in the current service area of the Park County landfill for the next 20-year period. As depicted in the table, it is estimated that the waste quantities generated in the current landfill service area will increase

TABLE 2

WASTE GENERATION RATE ANALYSIS

Jurisdictional Area	Waste Quantity (Tons/Year)	Estimated Current Population	Average Waste Generation Rate (lbs./cap./day)
1. Livingston Area	7,303(1)	8,215	4.87
2. Remainder of County	3,884(2)	4,335 (3)	4.91
TOTAL –	11,187	12,550	4.88

(1) Includes all waste generated by City, individuals, B.N.R. and contractors.

(2) Includes waste collected by rural container system and Hillman.

(3) Does not include Clyde Park (est. population 250).

TABLE 3

PROJECTED SOLID WASTE QUANTITIES
(Tons Per Year)

Jurisdictional Area	Current	Year 2000[1]
1. Livingston Area	7,303	11,314
2. Remainder of County	3,884	6,161
Subtotal:	11,187	17,475
3. National Park Service	3,221	3,543
TOTAL:	14,408	21,018

1 Based on populations of 12,730 for Livingston area and 6,876 for remainder of county (excluding the community of Clyde Park) and waste generation rates calculated in Table 2. Also assumes quantities of waste generated in Yellowstone National Park will increase ten percent over the next twenty-year period.

from the current 14,408 tons per year to approximately 21,000 tons per year by the year 2000. This represents approximately a 50 percent increase over the next 20-year period. Obviously, the current population projections and waste generation rates may differ dramatically within the next 20-year period, which will affect these projections. However, at this time it is felt that the current generation rates and projected populations are the most accurate information available.

4. Solid Waste Composition Breakdown

For the quantities of solid waste generated in the county it was also attempted to estimate that portion of the wastes that would be classified as Group II-type wastes and Group III-type wastes. Group II-type wastes basically include municipal and domestic wastes such as garbage and putrescible materials and general commercial and industrial wastes, excluding hazardous materials. Group III wastes basically include all inert materials and wood wastes.

Basically, the primary reason for estimating the breakdown of each of the two waste groups is twofold: 1) The manner in which the two groups of waste must be disposed of according to state regulations differs. Group II wastes must be disposed of in an environmentally safe manner, which requires the disposal site to be protected from groundwater sources and the wastes to be covered the same day they are disposed of; whereas Group III wastes may be placed in lowland areas and do not require daily cover due to the inert nature of the wastes. Also, Group III wastes are usually bulky in nature and cannot be collected and transported with conventional solid waste collection equipment or procedures. Thus, when evaluating certain solid waste collection and handling alternatives for the wastes generated in an area, special precautions and arrangments must be made to dispose of these type materials. 2) When evaluating the potential of recovering energy and secondary materials from the wastes generated in an area, Group III wastes usually are not applicable, due to the bulky and inert nature of the materials. Thus, when alternatives that include the processing and separation of the various recoverable materials which are found in the solid waste stream are evaluated, alternative disposal methods must be evaluated for the Group III wastes.

To estimate the breakdown of the solid waste generated in the county by the two classes, the Consultant reviewed the waste classification information that is recorded daily by the landfill gate attendant. From this information the Consultant was able to determine the estimated types of materials that could or could not be processed at a waste handling or incineration facility.

To determine the quantities of Group II and Group III materials disposed of at the Park County landfill, the Consultant made the assumption that all special categories in which the wastes are classified by the landfill gate attendant, with the exception of the category of "Decomposable Refuse", would be categorized as Group III waste. Based on this assumption, the Consultant reviewed all daily records for which waste classification data was available during the one-year period of August, 1978 through July, 1979. From the information reviewed, the Consultant determined the percentage of each type of waste deposited by each of the seven major generation sources.

A summary of the types of waste transported to the landfill by each of the seven generation sources is depicted in Table 4. As shown, it is estimated that approximately 90 percent of the wastes generated in the current landfill service area are considered to be Group II-type wastes. This basically indicates that this waste quantity could be accepted and processed at a mechanical solid waste handling facility. For the remaining portion of the wastes (10 percent), it would be required to dispose of these wastes at either a Class II site (conventional landfill) or a Class III site (demolition - debris site), regardless of the type of waste handling or incineration facility that might be utilized for the conventional wastes generated in the area.

TABLE 4

PARK COUNTY LANDFILL
SOLID WASTE COMPOSITION BREAKDOWN

	Generation Source	Total Waste	Group II		Group III	
			Percent	Tons	Percent	Tons
1.	City of Livingston	5,778	94	5,431	6	347
2.	Park County	3,507	96	3,367	4	140
3.	Hillman	377	90	339	10	38
4.	Individuals	411	83	341	17	70
5.	B. N. R.	277	84	233	16	44
6.	N. P. S.	3,221	99	3,187	1	32
7.	Contractors	837	15	126	85	711
	TOTAL –	14,408	90.4	13,026	9.6	1,382

PART THREE

RECYCLING FEASIBILITY ANALYSIS

PART THREE

RECYCLING FEASIBILITY ANALYSIS

A. GENERAL

The primary objective of this section of the study is to identify and evaluate existing and potential markets for recoverable materials in the solid waste generated in the county. The information obtained from thie investigation will be used to determine the potential of implementing recycling programs in the county. The potential for implementing a solid waste recycling program is directly dependent upon markets for the recoverable materials. Revenues from the recoverable materials must be obtained to offset the costs of collecting and separating the wastes, in most cases. If revenues for the recoverable materials cannot be obtained, other methods of disposal will be more economical.

Historically and at the present time, the markets for recoverable materials have shown significant fluctuation. The fluctions may be attributed to a number of outside forces. Among these are: 1) supply and demand for specific materials; 2) strikes in virgin material industries; 3) governmental influence through tax or price incentives; 4) foreign purchases; and 5) transportation costs. In general, markets for recoverable materials have shown an upward trend similar to that of most other commodities. Although future prices are extremely difficult or impossible to predict, it would be reasonable to expect this trend to continue. In addition to the economic factors, environmental, technological, political and sociological forces are emphasizing recycling programs as a desirable and practical alternative to conventional solid waste disposal. The extreme fluctuations in price and quantities are lessened in magnitude and frequency as the market for recoverable materials increases. When prices are adequate enough to make recycling attractive, many individual waste generators practice recycling. When the market drops below a certain economic level, these recycled materials become solid waste.

B. TYPES AND QUANTITIES OF RECOVERABLE MATERIALS

An important factor which must be determined prior to the evaluation of the feasibility of recycling solid wastes is the quantity and composition of wastes generated in the area. Generally, there are two types of recoverable materials found in solid wastes: 1) secondary materials which

can be reused, such as newsprint, corrugated and glass; and 2) those materials which can be used as a fuel source to generate steam, electricity and/or heat. The analysis included in this chapter summarizes the feasibility of recovering those secondary materials generated in the area. The analysis evaluating the feasibility of utilizing solid waste as an energy source will be included in the following chapter.

A detailed investigation of the quantity of solid waste was conducted in Part Two of this report, and quantities of waste were derived by applying typical waste generation rates to the estimated number of residents in the county for the current year and the year 2000. Through analysis of the detailed solid waste quantity and composition investigations conducted for the State of Montana during the State Solid Waste Management and Resource Recovery Study in 1976, it was possible to obtain composition data for the wastes generated in the county. During this study, solid waste samples were taken from several areas of the state. For each sample, the various constituents found in the wastes were weighed. Based on the sampling program, average composition data for the wastes generated in the state were developed.

In most instances the recoverable secondary materials that are practical to recycle are limited to ferrous and non-ferrous metals, separated newsprint and corrugated, and glass. In some instances other materials such as clothing, rubber and wood products are economically recoverable. However, these instances are uncommon and will not be investigated to a great degree in this study.

The estimated quantities of recoverable secondary materials generated in the county are depicted in Table 5. The quantities of materials depicted are based on the waste generation information developed in Part Two of this report and the waste composition data that was determined applicable from the state-wide solid waste study conducted in 1976. As the table indicates, approximately 850 and 144 tons of recoverable ferrous and non-ferrous metals, respectively, are generated in the county annually. Also, 2,709 and 1,109 tons of paper and corrugated, respectively, are generated and potentially recoverable annually. If market conditions are favorable, it is anticipated that a majority of this material could be recovered economically and effectively.

C. MARKET ANALYSIS FOR SECONDARY MATERIALS

A review of potential buyers for materials which may be recovered from the county's solid waste indicates that real markets presently exist for many products. Before such materials gain acceptance and are in demand in the market place, however, new developments must occur within the industry to make these commodities attractive. In all cases the recovered materials must meet strict specifications set down by industry in order to command the highest market price. In most cases, a

TABLE 5

SUMMARY OF SOLID WASTE COMPOSITION FOR STUDY AREA

(Tons Per Year)

Characteristic	Average % [1]	1979 Quantity
Combustibles		
Paper	18.8	2,709
Cardboard	7.7	1,109
Other	31.7	4,567
Subtotal –	58.2	8,385
Non-Combustibles		
Ferrous	5.9	850
Non-Ferrous	1.0	144
Glass	4.3	620
Other	30.6	4,409
Subtotal –	41.8	6,023
TOTAL –	100.0	14,408

[1] "Population, Employment and Waste Generation Report" prepared for the State of Montana Department of Health and Environmental Sciences in 1976.

a recycling program should be designed to be flexible enough so that if one market slows down or fails, any single unit process for a commodity can be discontinued or shifted to another market without disrupting the future of the program. During such a slowdown, it would be useless for the program to continue to recover that product if no other market was available. In some situations it may also be profitable to stockpile the material awaiting a favorable change in market conditions rather than to discontinue collection of the materials.

The basic objective of the product identification and marketing portion of this study is to identify the various potential buyers who exist for the products which could conceivably be separated from solid wastes within the study area. It is apparent that a large array of products could possibly be recovered from the solid waste generated in the area. In order to explore the market potential of the alternative products more efficiently, these products have been grouped into several major categories: 1) ferrous metals; 2) non-ferrous metals; 3) glass; and 4) paper products. The first phase of the task in this projects was to identify the major processes used in the recovery of the material and the uses the material may serve. Then local markets, other Montana markets and national markets were addressed for each of the major categories.

The Consultant utilized several different sources of information to identify potential buyers of the alternative products which could be recovered from the solid wastes generated in the area. Inquiries were made to several national and state industrial and trade associations requesting their assistance in identifying members of their associations who may be considered potential buyers for these products. As the list of potential buyers increased, specific inquiries were formulated and sent to these potential buyers. These inquiries basically identified the required material specifications, the capacity each potential buyer might have for recovered materials, and the pricing structure associated with each of the potential products. Included herein is a summary of the investigations which were conducted to determine the feasibility of recovering secondary materials from the solid waste generated in the county.

1. Ferrous Metals

(a) General Uses

Basically, there are two types of markets for the ferrous metals recovered from solid wastes; chemical processing and remelt applications. The chemical processing markets include tin recovery and copper precipitation. De-tinning is an industrial process which recovers tin from tin-plated steel. The usual sources are cans rejected in the can manufacturing process and cans recovered from municipal solid waste before incineration. The process can generally obtain about 7½ pounds of tin from each ton of scrap cans, and is this country's only source of domestic tin. The product must not be tightly baled or compressed,

as the process of de-tinning depends upon a chemical reaction with the surface of the metal. The copper precipitation technique involves the leaching out of copper from reclaimed cans. Through a complex series of chemical reactions, the process of chemical leaching continues until the supply of iron ore is exhausted and deposited as insoluable iron. This process is one of few economically feasible ways of recovering copper from low-grade ores. Approximately three tons of ferrous metals are needed to produce one ton of copper.

The utilization of steel scrap in the steel-making industry is tradtional. The use of steel cans as a scrap material is not new, but until recently only small percentages were used in each melt. At the present time scrap steel cans, which comprise the major portion of ferrous metals found in municipal residential wastes, can be melted in most types of furnaces. One of the problems steel companies are currently concerned with is oxidation caused by exposure to the elements and by incineration. Proper care in the refuse processing cycle will minimize the problem and maintain high standards. A high bulk density is required, and many companies insist on bales or bundles of this material for transportation and operational convenience.

Another process dealing with refuse-derived steel is the production of ferro-alloys where iron is contained with controlled amounts of other elements and used as an additive in melts for alloy steel. Iron foundries represent a relatively new potential market for ferrous metals recovered from municipal refuse. Both of these processes require shredding of the material, and the density of the material should be as high as possible to minimize transportation costs.

(b) Specific Markets

Through the market analysis it was determined that several potential markets for recoverable metals generated within the county are available. Table 6 summarizes the local, state and national markets as well as current pricing information.

From the inquiries made to national makets, high interest was shown in purchasing the ferrous materials which would result from a recycling or resource recovery program in the study area; however, it was determined that it is not currently profitable with the present freight rates and transportation to ship the ferrous materials to these market locations. Two of the firms contacted, Wisconsin Metal and Chemical Corporation and Vulcan Materials Company, located in Milwaukee, Wisconsin and Sandusky, Ohio, respectively, indicated that because of the distance to their closest plant and the high freight costs involved they could not be considered a potential market in Montana at the present time.

TABLE 6

FERROUS MATERIAL MARKETS

Local Market	Other State Markets	National Market	Market Price [1]
Pacific Hide & Fur Bozeman	Pacific Hide & Fur Billings, Butte, Great Falls, Helena, Missoula		$25-$55/ton
Carl Weissman & Sons Bozeman	Carl Weissman & Sons Great Falls, Billings, Butte		$20-$55/ton
	McCracken Metals, Inc. Butte		$20-$55/ton
	ASARCO, Inc. East Helena		Variable
	Anaconda Co. Butte		Variable
	Billings Recycling Center Billings		$.05/lb. - steel cans
	Montana Recycling, Inc. Missoula		$.05/lb. - steel cans

[1] Represents pricing structure as of March 15, 1980.

With regard to state markets, several were contacted and showed considerable interest in purchasing recovered ferrous materials. One industry located within the state, the Anaconda Company (located in Butte), could be considered as a potential user of the ferrous products. The Anaconda Company is presently operating a copper precipitation plant and utilizes substantial quantities of shredded and detinned ferrous metal in their process. Officials indicated that they would be interested in purchasing metal from a resource recovery facility if the material met their specifications. Several other state markets were also addressed. These included companies located in Billings, Butte, Great Falls, Missoula and Helena. These markets for ferrous materials include ASARCO, Inc., a custom lead smelter in East Helena, and Pacific Hide and Fur Depot in Helena. The ASARCO smelter utilizes scrap iron to supplement coke in the plant's blast furnace. Strict specifications must be met before the ferrous material would be accepted. Pacific Hide and Fur is an operation that accepts several types of ferrous products.

Several scrap metal dealers located near the county could be considered potential markets for secondary ferrous materials generated within the study area. The Pacific Hide and Fur Depot and Carl Weissman and Sons, Inc. all serve the general area.

2. Non-Ferrous Metals

(a) General

Although non-ferrous metals, which are comprised primarily of aluminum, represent less than one percent of the municipal solid waste, once separated these materials are extremely valuable. If these products are segregated and in a pure form, there are many prospective buyers. Current technology permits the isolation of an "aluminum-only" product by two distinct types of processes which may be used after the general waste has been shredded and ferrous metals have been magnetically removed. One process involves a chemical additive to a water suspension in which the aluminum is sitting. The aluminum will float to the surface and thus separate itself. The recovered aluminum is a mixture of various aluminum alloys and other light metals and has value and can be marketed, but the price it commands reflects its relatively poor quality. Recently another process was developed whereby devices (called eddy current separators or aluminum "magnets") isolate an aluminum fraction made up of predominantly aluminum beverage cans. Since this material is essentially a single alloy, its market value is substantially higher than that produced by the previously mentioned process.

Recovered aluminum is currently being purchased by two major markets; aluminum producing companies and aluminum smelters. Beverage cans separated manually and

collected by recycling groups and aluminum can stock recovered by the eddy current process are remelted by the major aluminum companies to make new beverage can stock. Mixed alloy aluminum scrap is purchased by aluminum smelters.

Mixed non-ferrous metals account for a small portion of the total non-ferrous metals that can be recovered from solid waste. This portion of the waste consists of small quantities of copper, lead, zinc, brass and other metals. Each of these metals is valuable in itself, but extensive operations to isolate individual non-ferrous metals other than aluminum are generally not economically feasible. The type and quantity of metals present in the product will govern the material's market value.

(b) Specific Markets

With regard to potential markets for the non-ferrous metals resulting from a recycling program or facility, it was determined that a definite national market does exist for these type of materials. Pacific Iron and Metal Company in Seattle, Washington expressed an interest in buying any clean or contaminated scrap metal. Several regional firms expressed an interest in purchasing these non-ferrous materials, primarily aluminum. Recycling centers in Boise, Idaho and Spokane, Washington also indicated a desire to purchase quantities of non-ferrous scrap.

Numerous state markets were addressed and considerable interest has been shown regarding the purchase of non-ferrous materials recovered from the area. Montana Recycling, Inc., located in Missoula; Recycling Centers located in Billings, Butte and Great Falls; McCracken Metals and Energy Conservation Service of Butte, as well as the Pacific Hide and Fur group are potential buyers for this category of material. Several operations are strictly concerned with the aluminum fraction. A future market for scrap aluminum is the Anaconda Aluminum Plant located in Columbia Falls. Company officials have suggested that there is a good possibility for the recovery of scrap aluminum in the long-term, but not in the near future. At present, the Anaconda Company purchases a small quantity of aluminum beverage cans from a non-profit recycling center in Kalispell.

Local markets consist of scrap metal dealers in Bozeman who accept scrap aluminum and other types of non-ferrous scrap metals. Several beverage distributors, particularly Coors beer distributors, operate recycling programs for all types of aluminum beverage cans. Bozeman and Livingston recycling centers also recycle all types of aluminum and selected non-ferrous metals.

The following table summarizes the potential markets for the non-ferrous metals that could possibly be received from solid waste within the county. The table also indicates the current market price for each potential market.

3. Glass

(a) General

Recovered glass can be used as cullet material that is remelted for the manufacture of new glass containers. This process has been used by nearly all glass container manufacturers using glass bottles and jars collected manually and color-sorted by recycling centers. Color-sorted glass is in demand periodically by glass companies, especially when difficulties in obtaining raw materials are encountered. As a result of raw material shortages, glass companies have taken a renewed interest in all sources of used glass, attempting to hold the costs down on glass container production. The major obstacle for any recycling program lies in implementing a system that can meet the purity and color-sorting requirements and accomodate transportation costs. Presently a market has developed for non-color-sorted, refuse-derived glass. When a company has a furnace which produces colored glass, some amount of non-color-sorted glass cullet can be safely used in the mixture. This non-color-sorted glass cullet can be added to the batch up to a certain point.

(b) Specific Markets

An investigation into the location of glass container manufacturing plants indicates that there are very few glass manufacturing industries in the nation that are close enough to Montana to be considered potential markets. The analysis indicates that there are two potential markets in the Pacific Northwest which could utilize glass resulting from a recycling program located within the study area. The Owens-Illinois Corp. has two glass container plants; one located in Seattle, Washington and another in Portland, Oregon. At the present time, however, freight costs are prohibitive and utilization of these regional outlets is unfeasible.

Markets located within the state include the recycling centers located in Billings, Great Falls and Butte as well as Montana Recycling, Inc. of Missoula. These centers generally accept many types of returnable beverage bottles. Locally, the Bozeman and Livingston Recycling Centers and the Coors Beer distributor in Bozeman will accept certain beverage bottles, depending upon the type and site.

Summarized in the following table is a brief review of the market locations for glass and the respective current market prices.

TABLE 7

NON-FERROUS MATERIAL MARKETS

Local Market	Other State Markets	National Market	Market Price [1]
Bozeman Recycling Livingston Recycling			$.08-.20/lb. alum.
Pacific Hide & Fur Bozeman	Pacific Hide & Fur Billings, Butte, Great Falls, Helena, Missoula		$.10-.25/lb. alum. $.30-.60/lb. misc.
Carl Weissman & Sons Bozeman	Carl Weissman & Sons Great Falls, Billings, Butte		$.12-.25/lb. alum. $.35-.60/lb. misc.
Mountain Country Coors Bozeman	Coors Distributors - Statewide		$.25/lb. alum.
	McCracken Metals Butte		$.25-.27/lb. alum. $.30-.50/lb. misc.
	Recycling Centers Billings, Butte, Great Falls		$.08-.27/lb. alum.
	Energy Conservation Service Butte		$.25-.27/lb. alum. $.35-.75/lb. other
	Montana Recycling, Inc. Missoula		$.20-.30/lb. alum.
		Western Recycling, Inc. Boise, Idaho	$.30/lb. alum.
		Wastepaper Service, Inc. Spokane, Washington	$.30-.37/lb. alum.
		Pacific Iron & Metal Co. Seattle, Washington	Varies w/market

1 Represents pricing structure as of March 15, 1980.

TABLE 8

GLASS MARKETS

Local Market	Other State Markets	National Market	Market Price [1]
Bozeman Recycling Livingston Recycling			$.25-.50/case
Mountain Country Coors Bozeman	Coors Distributors - Statewide		$.25/case
	Montana Recycling, Inc. Missoula		$.25-.50/case
	Recycling Centers Billings, Butte, Great Falls		$.25-.50/case
		Owens-Illinois, Inc. Portland, Oregon	$25-35/ton (delivered)
		Northwestern Glass Seattle, Washington	$25-35/ton (delivered)

[1] Represents pricing structure as of March 15, 1980.

4. Paper Products

(a) General

For many years newsprint, corrugated and mixed office papers have been a source of fiber for the paper industry. Approximately 40% of the recycled material can be directly recovered by industry and 60% may be salvaged by post-consumers. Most post-consumer corrugated and mixed papers are collected by representatives of the salvage industry from selected industrial and commercial establishments on pickup routes. These materials are usually clean as they have not been mixed with residential wastes. If market conditions are favorable, hand sorting can be accomodated within the operating margins created by reasonable market prices.

Newsprint can be separated by homeowners and bundles can be collected by regular or slightly modified collection vehicles and by special pickup vehicles. Also, newsprint can be collected by civic groups and industries by providing appropriate containers, appeals for newsprint through the media and favorable pricing. Generally the product must be clean, bundled and free of moisture, magazines or other special papers. Industry approves this type of operation because they can easily regulate the flow of material and to some degree set the price for the commodity.

Several other processes exist for the recovery of paper products, one such method is the mechanical processing of mixed municipal wastes in large recovery plants. Very little paper recovery, however, presently takes place using these mechanical processes since the recovery fiber is not competitive with virgin fibers. Another possibility is to process the paper along with other post-consumer wastes by converting it to some usable form of energy, such as gas, oil, steam or electrical power.

In general, there are three major types of recovered paper products that may be separated through a recycling program. They are:

1) Used containers, both solid fiber and corrugated, and container plant scraps.

2) News, which includes newspapers, special newsprint of deink quality, etc.

3) Mixed papers, which includes mill wrappers, boxboard cuttings, IBM cards,

computer printouts, book stock and magazines, news and publication blanks, draft paper and other various papers.

The operations that use waste paper as a raw material are extremely concerned about contaminants such as plastics, metals and oils which have a serious impact on their process. It is very probable that recycled papers could not be acceptable for food repacking users because of public health concerns.

(b) Specific Markets

(1) Newsprint Markets

Recycled newspapers are used in a number of products within the paper industry. Old newsprint is used primarily in the manufacture of boxboard; however, it is also used in the production of chipboard, newsprint and building materials such as roofing felt, insulation board, and gypsum liner board. The market is subject to great fluctuations, but continued gradual growth is anticipated in the future.

From inquiries made to national markets, it was determined that potential markets do exist for waste paper recovered from the study area. Several markets located in Seattle and Spokane, Washington and Hyrum, Utah have indicated their interest in purchasing newsprint for use in the manufacture of cellulose fiber insulation. Interest in using newsprint from re-pulping has also been shown by a Seattle-based firm. In addition, recycling centers in Boise, Idaho and Spokane, Washington have expressed a desire to purchase waste newsprint and will presumably act as brokers selling to consumer mills.

In recent years, the market potential within the state has developed considerably. Two Great Falls firms utilize newsprint as a raw material source in the manufacture of cellulose fiber insulation. Each expresssed a desire to obtain newsprint from recycling operations located within the county. Montana Recycling, Incorporated and recycling centers in Billings, Butte and Great Falls presently purchase newsprint and act as brokers dispersing quantities of the material to industry. Local newsprint markets consist of the Bozeman and Livingston Recycling Centers, which purchase quantities of newsprint from area residents.

Table 9 shows the current markets for newsprint on a local, state and national level and gives some indication of the current market pricing structure.

TABLE 9

NEWSPRINT MARKETS

Local Market	Other State Markets	National Market	Market Price [1]
Bozeman Recycling Livingston Recycling			$20/ton
	All-Weather Insulation Co. Great Falls		$60/ton delivered
	Robinson Insulation Co. Great Falls		$40/ton
	Recycling Centers Billings, Butte, Great Falls		$20-40/ton
	Montana Recycling, Inc. Missoula		$20/ton
		Western Recycling Co. Boise, Idaho	$30-45/ton (delivered)
		Wastepaper Service, Inc. Spokane, Washington	$40-60/ton (delivered)
		Thermoguard Insul. Co. Spokane - Seattle, Wash.	$55-80/ton (delivered)
		Mountain Fiber Cellulose Hyrum, Utah	$30/ton

[1] Represents pricing structure as of March 15, 1980.

(2) Corrugated and Mixed Paper Markets

The market potential for corrugated and mixed papers on a national level appears to be rather limited. Of the firms contacted only three, two in Spokane and one in Boise, expressed any interest in purchasing these materials from a program within the study area. The firms are brokers who in turn sell materials to paper mills and other manufacturers.

When investigating state markets for this type of material, several were located. Montana Recycling, Inc. located in Missoula, and recycling centers in Billings, Butte and Great Falls all accept various types of mixed papers. Each of these outlets readily purchases computer cards and computer printout paper. One outlet, the Billings Recycling Center, recently began to purchase corrugated paper in addition to the other types of paper. A local market for some types of waste paper exists at the Bozeman and Livingston Recycling Centers. These centers purchase computer cards and computer printout paper.

Table 10 summarizes the markets and prices for corrugated and mixed paper.

D. SUMMARY OF RECYCLING FEASIBILITY

Included in the following statements is a summary of the potential of economically recovering and marketing secondary materials found in the county's solid waste stream.

1. Ferrous Metals

(a) Regional Markets

In general, transportation costs are too prohibitive to transport ferrous metals any great distance (most regional markets are in excess of 600 miles from the county). Most markets have a considerably smaller area from which they may purchase ferrous materials economically.

(b) Local Markets

The Anaconda Company, located in Butte, has the demand and potential for developing into a local market for these materials. However, their current market policies forbid the purchase of small quantities of ferrous metals. This potential market should be continually investigated as market conditions change.

TABLE 10

CORRUGATED AND MIXED PAPER MARKETS

Local Market	Other State Markets	National Market	Market Price [1]
Bozeman Recycling Livingston Recycling			$100-120/ton (cards & printout)
	Billings Recycling Center Billings		$20/ton (corr.) $80-120/ton (cards & printout)
	Recycling Centers Butte, Great Falls		$60-120/ton (cards & printout)
	Montana Recycling, Inc. Missoula		$80-100/ton (cards & printout)
		Western Recycling Co. Boise, Idaho	$30-45/ton (baled & delivered - corr.) $140-160/ton (cards & printout - deliv.)
		Wastepaper Service, Inc. Spokane, Washington	$40-60/ton (baled -corr.) $150-175/ton (cards & printout)
		Thermoguard Insul. Co. Spokane, Washington	$70-90/ton (baled - corr.)

[1] Represents pricing structure as of March 15, 1980.

It appears that on the local and state level the major markets for ferrous materials exist with the scrap dealers located throughout the area. A sufficient number of scrap dealers have shown an interest in obtaining any ferrous material from a recycling program to assume that the quantity of ferrous materials that may be recoverable could be sold to them.

2. Non-Ferrous Metals

(a) National Markets

National markets do exist in the midwest and on the west coast for non-ferrous materials; however, high transportation and freight costs appear to make these markets uneconomical at this time.

(b) Local and State Markets

Many local and state scrap dealers are interested in obtaining all types of non-ferrous metal products. The price structure for these non-ferrous metals appears to be the most economical one on which to base a recovery program. There appear to be several markets for aluminum and the other non-ferrous metals in or near the county.

3. Glass

(a) Regional Markets

A potential market does exist with the Owens - Illinois plants in the Pacific Northwest (Seattle and Portland), but only if freight rates and transportation costs are not excessive and recoverable glass exists in sufficient quantities to make the transaction profitable. Currently, however, transportation costs exceed the material's market value.

(b) Local and State Markets

Collection centers in close proximity to the county do exist for certain types of beverage bottles, but none exist for other types of waste glass. These markets should be utilized to the maximum extent possible.

4. Paper Products

Although national markets do exist for some paper products recovered from this area, it appears more feasible to utilize the markets within the state. As previously mentioned, there are several operations within Montana that utilize newsprint for the manufacture of cellulose fiber insulation. These markets, along with others, should continue to be utilized.

PART FOUR

EVALUATION OF ALTERNATIVE DISPOSAL SYSTEMS

PART FOUR

EVALUATION OF ALTERNATIVE DISPOSAL SYSTEMS

A. GENERAL

The purpose of this chapter of the study is to evaluate in depth those solid waste handling and disposal concepts which appear to be most applicable for economically solving the inefficiencies and deficiencies of the existing disposal methods in Park County. Currently throughout the nation there are a multitude of concepts being utilized to process, transfer, incinerate and dispose of solid waste. In most instances the local topographic, climatic, sociologic and political conditions dictate which alternative(s) is most practical and economical for the area.

Through a detailed literature search, on-site investigations and the Consultant's past experience, it was determined that four general concepts have potential applicability in Park County. These include: 1) sanitary landfill; 2) baling; 3) transfer stations; and 4) incineration with heat recovery. Several other alternatives including shredding, air classification, incineration without heat recovery, composting and methane recovery from landfill, to mention a few, were preliminarily evaluated but eventually eliminated from serious consideration due primarily to the relatively small volumes of waste generated in the county and/or the lack of a proven "track record" for the installations that have been in operation in the past several years.

To evaluate the various alternatives which were determined applicable for the county, initially a basis of design and cost estimates were prepared for the various system cost components included for each potentially applicable alternative. Basically, the system cost components for each alternative included two major elements: 1) capital and annual costs for major facilities determined necessary; and 2) transportation costs, including depreciation and operational expense to operate vehicles involved in the transportation of solid wastes from where the wastes are transported to the alternate handling facility to the final disposal location.

Included in Section B of this chapter is a detailed description of the basis of design and cost estimates for the various system cost components that were prepared for this project. This information was then utilized as the basis for evaluating the specific alternatives which were determined potentially applicable for the county. These specific system cost analyses are included in Section C of this chapter.

B. DESCRIPTION OF APPLICABLE ALTERNATIVES

1. Design Criteria

When designing a solid waste handling or disposal facility, the two major criteria that initially must be evaluated include: 1) the anticipated quantities of solid waste brought to the proposed facility; and 2) the estimated number and types of vehicles that will be utilizing the facility. Included herein is a brief discussion of the design criteria determined applicable for this project.

(a) Solid Waste Quantities

The current and projected quantities and composition of solid waste generated within the Park County landfill's present service area was summarized in Chapter Two. As summarized in that chapter, the current quantity of waste being disposed of at the Park County landfill is approximately 14,400 tons annually. It was estimated that this quantity will increase approximately 50 percent in the next twenty-year period. As further depicted in Chapter Two, the estimated waste quantity that could be brought to a solid waste handling or incineration facility would be approximately 90 percent of the total waste generated. It is anticipated that the remaining 10 percent would be comprised of inert materials consisting of tree wastes, demolition debris, fill material, and sludges and oils, which would require alternative disposal methods regardless of the waste handling methods that were evaluated herein for replacement of the existing county landfill.

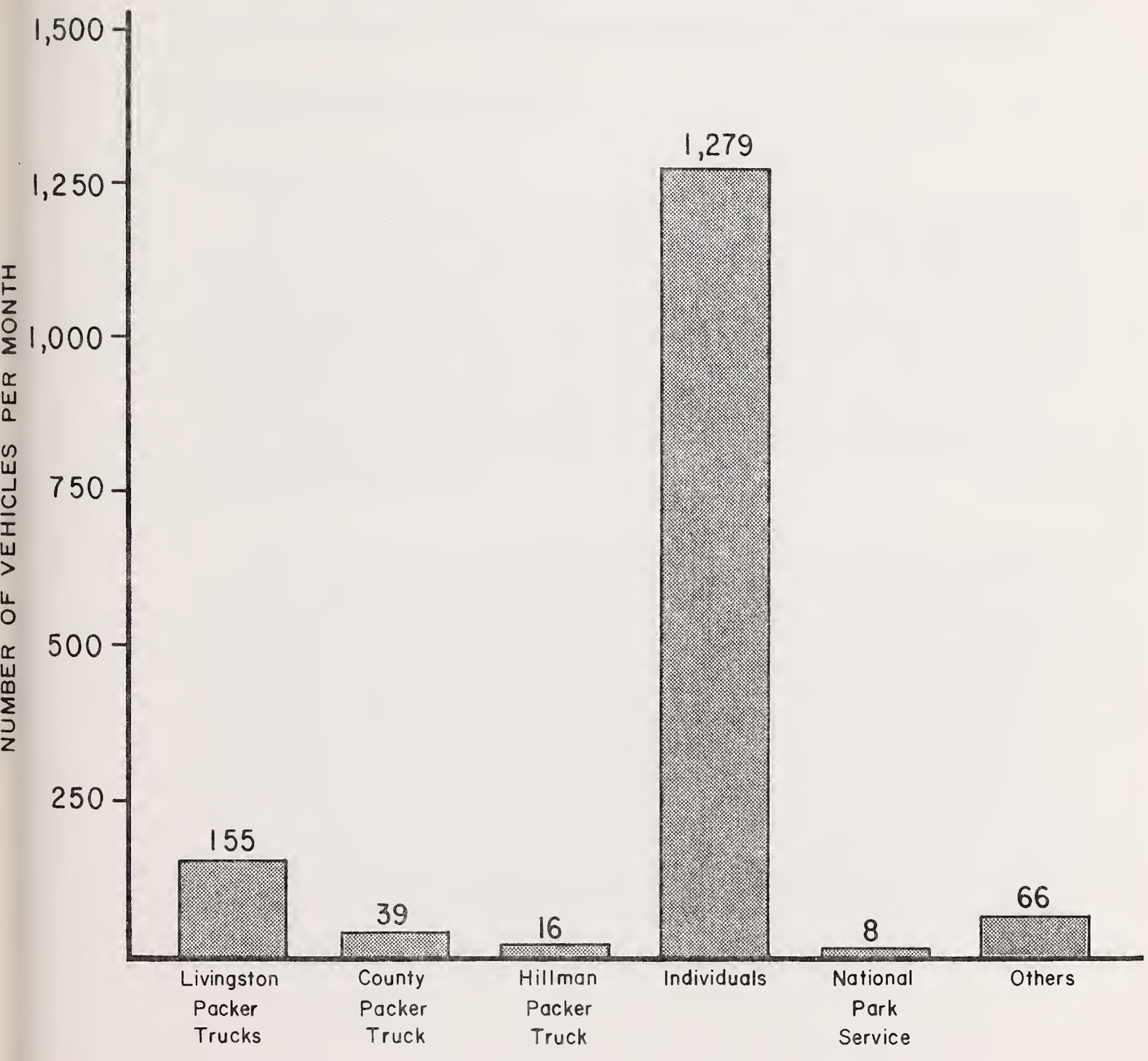
The basic concern when designing a solid waste handling facility is to assure that the facility can handle the peak quantity of waste that could be generated in any one particular day. As depicted in Figure 1, the peak quantity of wastes is generated in the summer months. According to the figure, it is estimated that approximately 1,900 tons of Class II-type wastes (processable) are currently being disposed of during each of the summer months. Assuming that the landfill is open six days per week during this period, which further equates to 26 days per month, it can be anticipated that approximately 70 to 75 tons of waste must be handled daily during this period. Also, as discussed previously it is anticipated that this quantity is expected to increase approximately 50 percent to 100 tons per day by the year 2000. Based on this premise, it is recommended that any solid waste handling facility that would replace the Park County landfill should have the capacity to handle a minimum of 75, and preferably 100, tons of waste per day. This assumes that the facility's service area would remain the same as at present. Obviously, any change in the service area would require a re-evaluation of the facility's sizing requirements.

Due to potential equipment breakdowns at a waste handling facility, it is also quite advantageous to construct a facility that has either backup equipment or additional waste storage capability. In most instances the least-cost solution for this is to provide additional waste storage capability. When storing wastes, there are primarily two storage concepts available: 1) additional area on the waste receiving floor, or "floor storage"; and 2) a receiving pit, usually constructed of concrete. Regardless of the type of storage concept utilized, it is usually most practical to have the capability to store a minimum of two days' generation of solid waste. Assuming solid waste has an average "as-received" density of 250 lbs./cu. yd., a storage area of approximately 1,200 cubic yards would be required to store a two-day waste accumulation. This equates to an approximate area of 60 feet by 60 feet, if waste is stacked nine feet high. Thus, it is recommended that any waste handling facility should be designed and constructed to provide this minimum storage area.

(b) Vehicles

In order to determine the maximum number of vehicles that would be anticipated to utilize a solid waste handling facility at any one time, the landfill records for the past one-year period were reviewed. This review indicated that the peak number of vehicles that enter the Park County landfill occurs during the month of May. During this month it was determined that approximately 2,900 vehicles utilized the landfill. It was further determined that approximately 1,563, or 54 percent, of the vehicles entering the landfill were transporting typical municipal waste, with the remainder hauling Group III materials (demolition debris, trees, etc.). Figure 4 summarizes these vehicles by generation source. As depicted in this figure, it is quite obvious that the majority of vehicles entering the landfill can be categorized as individuals with either automobiles or pickups.

To determine the peak number of dumping spaces that would be required to adequately serve the individuals who may utilize a solid waste handling facility, it was attempted to determine the maximum number of vehicles per hour that utilized the existing landfill during May, 1979. By dividing the 1,563 Group II-type waste haulers that utilized the site during that month by the number of days the site was open (26), an average of 60 vehicles per day was calculated. By further utilizing information obtained from a survey conducted by Park County personnel during the week of September 10, 1979, it was determined that the peak hourly number of vehicles utilizing the landfill represents 17 percent of the total vehicles that utilized the site during that particular day. Thus it was estimated that the peak number of vehicles that would utilize a waste handling facility in any one hour would be approximately ten vehicles (60 x .17 = 10.2).



Note: 1) Information recorded for month of May, 1979.

2) Vehicles transporting Group III materials (demolition debris, etc.) have been excluded.

PARK COUNTY LANDFILL
VEHICLE SOURCE SUMMARY

Figure 4

If the assumption is made that on the average, an individual can unload his vehicle in ten minutes, it would require two dumping stalls to adequately handle the haulers transporting waste to a waste handling facility. For this study it was assumed that a growth factor of 50 percent is potential over the life of a waste handling facility. Thus all facilites evaluated for this project were designed to accomodate three (3) vehicles simultaneously.

2. Evaluation of Applicable Facilities

(a) Sanitary Landfill

As previously discussed, Park County personnel have attempted to operate the current county landfill for the past two years without causing undue litter problems to surrounding property. However, the extremely windy conditions have made this task essentially impossible. The Park County governing board has attempted to locate a new landfill site within a reasonable distance of the City of Livingston. This effort, however, has been unsuccessful; primarily due to either the extensive area in which the extremely windy conditions prevail, or unfavorable permeable soil conditions prevalent throughout the Yellowstone River area.

Due to the initial unsuccessful attempts to either operate the current landfill site within compliance or to locate a suitable new landfill site, the "Scope of Work" for this project did not include further investigation into the alternative of operating a landfill site in the Livingston area. However, since the current disposal costs being assessed to the residents of Park County are directly reflective of the current landfill operation, it was attempted to identify the current landfill costs. From this current cost, the estimated annual costs for the other waste handling alternatives that were evaluated in this study could then be compared to identify possible annual cost increases (or decreases) as a result of utilizing one of the various other alternatives evaluated. The current estimated cost to operate the present landfill site is summarized in Table 11. As depicted, this annual cost is estimated to be $138,040.

(b) Baling Facility

(1) General

The primary purpose of baling solid waste is to considerably reduce the waste's volume. The reduction of the volume affords several advantages in the management of solid wastes. In regard to the transportation of solid waste, baling can significantly reduce the number of trips and correspondingly reduce the cost, if large waste quantities and large distances are anticipated. In regard to operating sanitary

TABLE 11

CURRENT LANDFILL COST

1. CAPITAL COST

Item	Units	Unit Cost	Total Cost
a) Land	25 acres	$2000/acre	$50,000
b) Sitework	—	Lump Sum	10,000
c) Fencing	5000 LF	$1.80/L.F.	9,000
d) Roads	1000 LF	$15.00/L.F.	15,000
e) Building	1000 Sq.Ft.	$15.00/S.F.	15,000
f) Misc. Utilities	—	Lump Sum	3,000
g) Engineering, Legal & Contingencies	—	15 percent	15,000
		SUBTOTAL —	$117,000
		Amortization (8% - 20 yrs.)	$11,900

2. ANNUAL COST

Item	Cost (1)
a) Dozer Payments	$25,120
b) Dozer Operation	15,000
c) Insurance	1,040
d) Trench Excavation	12,500
e) Contract Paper Pickup	10,000
f) Miscellaneous	600
g) General Landfill Operation & Maintenance	16,000
h) Labor	45,880
SUBTOTAL—	$126,140
+ Amortization Cost	11,900
TOTAL ANNUAL COST	$138,040

(1) 1979-1980 Park County Refuse Disposal District Budget

landfills in which wastes are baled initially, several advantages are also obtained. These include: 1) elimination of loose blowing paper and rubbish; 2) better control of flies and rodents; 3) elimination of expensive landfill compaction equipment; and 4) a decrease in operation and capital costs due to less cover material required and higher densities affording the conservation of land.

Several types of balers are utilized today throughout the nation. Some balers compress the waste to densities in excess of 3,000 lbs. per cubic yard, which do not require any type of binding. Other types of balers compact waste to lower densities, necessitating wire or twine ties. In the majority of instances, baling facilities utilize an enclosed building for waste dumping, conveying and processing.

(2) Specific Applicability and Facility Description

After evaluating the possible situations in the County, it was determined that two basic alternatives are present if solid wastes are baled. These include: 1) location of the baling facility near the current County landfill site with ultimate disposal of the baled refuse at the present site; and 2) location of the baling facility near the City of Livingston, with the baled refuse transported to the existing county landfill site. Under these options the current disposal site would continue to be operated as a Class III landfill to dispose of the inert and unprocessable Group III wastes which would continue to be generated in the county.

For either of the two baling options, the basic baling facility and its operation would be similar. The baling facility would be completely enclosed and would include a waste receiving (tipping) area, baling equipment area, bale discharge area, and an office-restroom. At the facility, all private waste haulers, individual businesses and private citizens would initially drive over a scale where each individual's waste load would be recorded. The vehicles would then enter the enclosed tipping area where the wastes would either be discarded directly into an eight-foot-wide apron feed conveyor or onto the tipping floor. A front-end loader would be utilized as required to maneuver the wastes from the tipping area onto the feed conveyor. Once on the incline apron feed conveyor, the waste materials would be transferred directly to the baler feed hopper. The baler required for this facility would have a maximum capacity of 15 tons per hour. The baler, which would have a compressive force of 135 tons, would produce wire-tied bales having dimensions of 3' x 4' x 5' and weighing approximately 2,400 lbs. The bales, after discharging from the unit, would be picked up by a forklift. For the option in which the existing landfill

would be located adjacent to the baling facility, the bales would be transported directly to the final disposal location by the forklift. For the option in which the baling facility would be located near Livingston, the bales would be loaded onto a flatbed. Once the bales were transported to the county landfill site, a front-end loader would unload the bales from the flatbed and place them in the landfill. Facility floor plans which depict the two basic baling operations are included in Figures 5 and 6.

(3) Facility Costs

The capital and annual costs to operate a facility to meet the demands of the two baling operations discussed above were estimated. The estimated capital and annual costs for the short-haul situation are summarized in Tables 12a and 12b, respectively. The estimated costs for the long-haul situation are summarized in Table 13. As depicted in Table 12a and Table 13, the estimated capital cost for the facilities that would meet the requirements of the two baling situations would vary from $865,000 to $965,000. The primary reasons for the increased capital cost for the long-haul option would be the need for a flatbed trailer and tractor, and a larger building for the bale loading area. Aso indicated in the respective tables is the estimated amortized cost for the two facilities.

The estimated annual cost to operate the baling facilities is summarized in Table 12b. As further indicated in Table 13, it is anticipated that the annual cost to operate the baling facilities would be the same regardless of whether the short- or long-haul situations were implemented. Obviously, the transportation costs of the two options would vary, depending upon the location of the baling facilities. Estimated transportation costs for these baling situations are included and evaluated in the "Annual System Cost Analysis", which is summarized at the conclusion of this chapter. It should also be noted that the annual cost included for these facilities assumes that the baling facility would be open five days per week.

In addition to the baling facility costs discussed above, the cost to operate the current county landfill as a bale-demolition debris landfill must also be addressed. Due to the operational conditions and criteria required to operate a disposal site for solid waste bales and miscellaneous Group III materials (demolition debris, etc.), it usually cost significantly less to operate a balefill than a sanitary landfill. Initially a bale landfill's useful life will be approximately 70 percent higher than a conventional landfill due to the higher in-place waste densities associated with baling waste

BALING FACILITY WITH SHORT HAUL

(FLOOR PLAN)

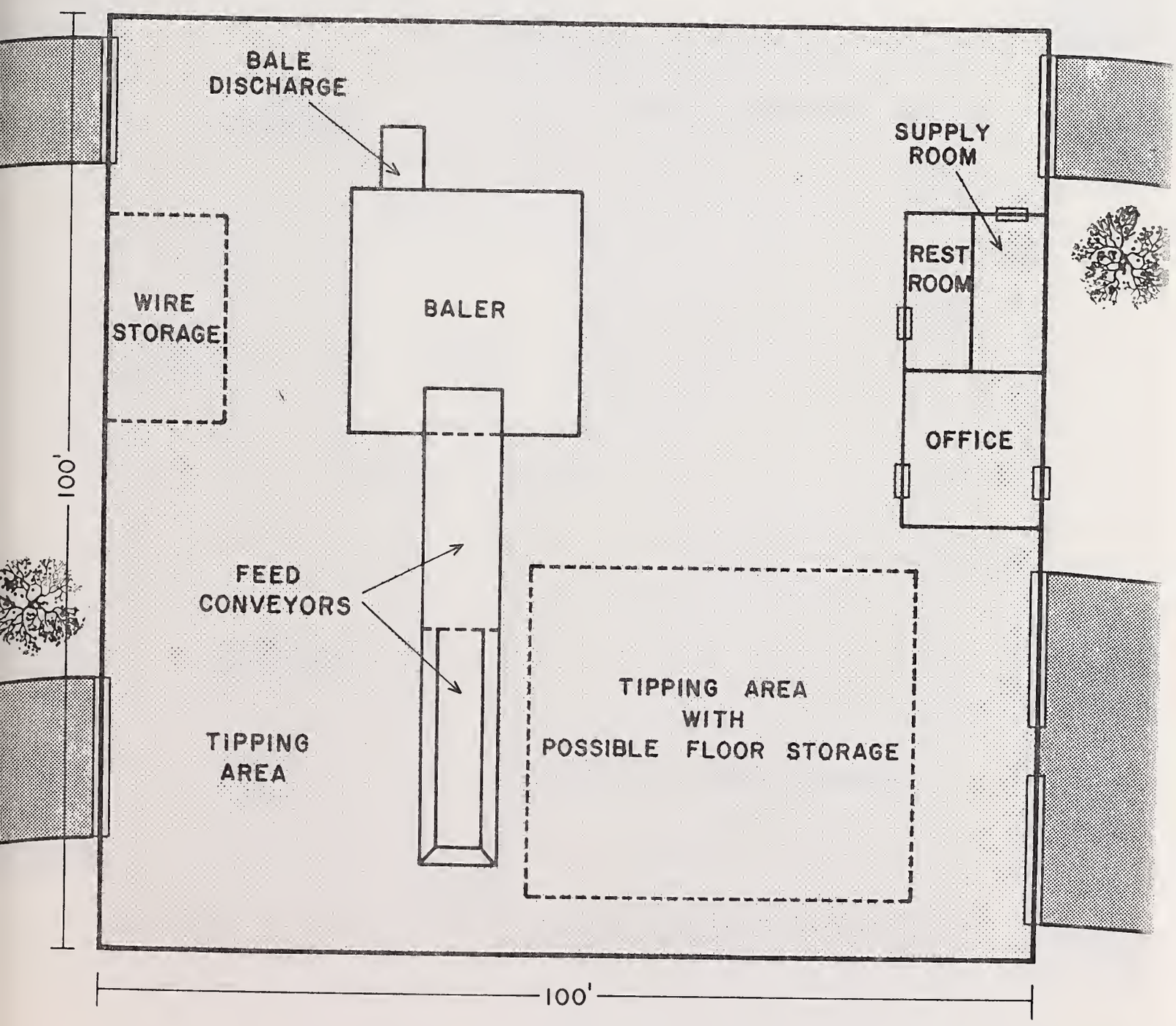


Figure 5

BALING FACILITY WITH LONG HAUL

(FLOOR PLAN)

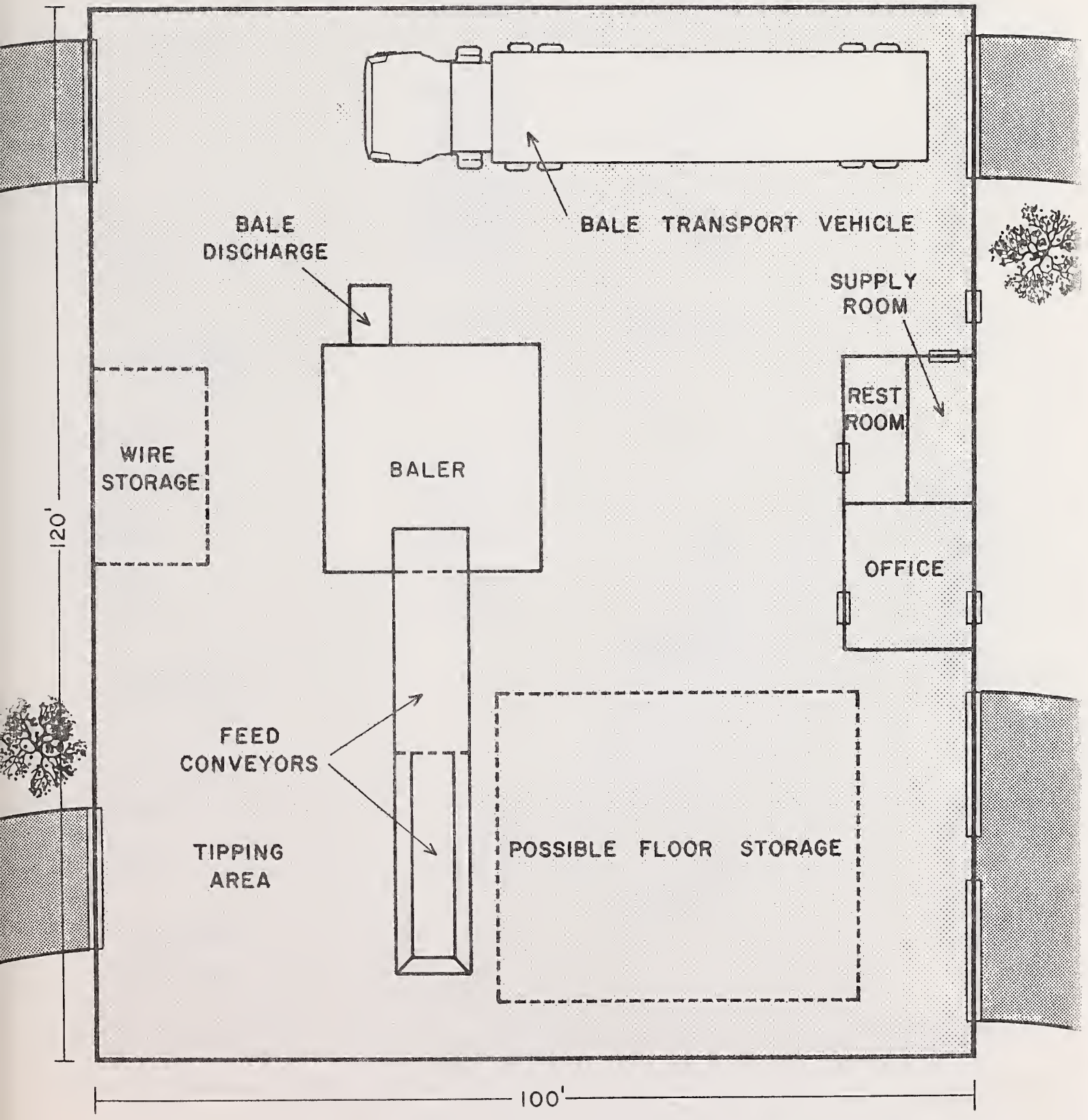


Figure 6

TABLE 12a

SOLID WASTE BALING FACILITY
WITH SHORT HAUL
(Capital Cost)

ITEM	Unit Cost	Units	Total Cost
A. FACILITY COST			
1) Land	$2000/acre	2.5 acres	$ 5,000
2) Sitework	Lump Sum	—	20,000
3) Building	$35/sq.ft.	100 x 100	350,000
4) Scale	Lump Sum	—	20,000
5) Utilities	Lump Sum	—	25,000
6) Engineering, Legal & Contingency	Lump Sum	20%	84,000
		SUBTOTAL —	$504,000
Amortization - (8% - 30 yrs.)			44,800
B. EQUIPMENT			
1) Baler (15 TPH)	Lump Sum	—	$165,000
2) Conveyors	Lump Sum	—	60,000
3) Installation	Lump Sum	20%	45,000
4) Spare Parts	Lump Sum	—	10,000
5) Contingency	Lump Sum	10%	28,000
		SUBTOTAL —	$308,000
Amortization - (8% - 15 yrs.)			36,000
C. ROLLING STOCK			
1) Front Loader	$35,000	1	$ 35,000
2) Fork Lift	15,000	1	15,000
3) Contingency	Lump Sum	10%	3,000
		SUBTOTAL —	$53,000
Amortization - (8% - 5 yrs.)			13,300
TOTAL CAPITAL COST —			$865,000
TOTAL AMORTIZED COST —			$94,100

TABLE 12b

SOLID WASTE BALING FACILITY
WITH SHORT HAUL
(Annual Cost)

ITEM	Unit Cost	Units	Total Cost
1) Utilities	Lump Sum	—	$ 10,000
2) Tie Wire	$1.10/ton	13,000 tons	14,300
3) Insurance	Lump Sum	—	1,500
4) Equipment Maintenance	$.65/ton	13,000 tons	8,500
5) General Supplies & Maintenance	Lump Sum	—	4,000
6) Labor			
a) Supervisor	$16,000	1	16,000
b) Baler Operator	14,000	1	14,000
c) Fork Lift Operator	14,000	1	14,000
d) Bobcat Operator - Laborer	14,000	1	14,000
e) Scale Attendant	10,000	1	10,000
7) Rolling Stock Oper. & Maintenance	20% capital	—	10,600
		SUBTOTAL —	$116,900
+ Amortization Cost			94,100
TOTAL ANNUAL COST			$211,000

TABLE 13

SOLID WASTE BALING FACILITY
WITH LONG HAUL

Item	Unit Cost		Units	Total Cost
1. CAPITAL COST				
A. Facility Cost				
1) Land	$4,000/acre		2.5 acres	$ 10,000
2) Sitework	Lump Sum		—	20,000
3) Building	$35/sq.ft.		100 x 120	420,000
4) Scale	Lump Sum		—	20,000
5) Utilities	Lump Sum		—	15,000
6) Engineering, Legal & Contingency	Lump Sum		—	97,000
		SUBTOTAL —		$582,000
		Amortization (8% - 30 yrs)		51,700
B. Equipment				
Same as Short Haul				$308,000
		Amortization (8% - 15 yrs)		36,000
C. Rolling Stock				
1) Front Loader	$35,000		1	$ 35,000
2) Fork Lift	$15,000		1	15,000
3) Flatbed Trailer	$18,000		1	18,000
4) Contingency	Lump Sum		10%	7,000
		SUBTOTAL —		$75,000
		Amortization (8% - 5 yrs.)		118,800
TOTAL CAPITAL COST				$965,000
TOTAL AMORTIZED COST				$106,500
2. ANNUAL COST				
Same as Short Haul				$116,900
+ Amortization Cost				106,500
TOTAL ANNUAL COST				$223,400

compared to standard landfill practices. Secondly, on-site maintenance and equipment use is substantially reduced due to the fact that costly on-site dozers and compactors are not required, whereas conventional landfills require almost constant use of these types of equipment for waste compaction as well as litter control. Finally, the labor associated with general maintenance, site supervision, equipment operation and trench excavation is also considerably less at a bale landfill. Included in Table 14 is the estimated cost to operate the current county landfill as a balefill - Class III landfill. As depicted in the table, the annual cost to operate the site five days per week is estimated to be $32,100. This compares to an annual cost of approximately $138,000 to operate the current county site as a conventional sanitary landfill.

c) Transfer Stations

The primary function of a solid waste transfer station is to reduce the total cost of hauling from the point of collection to the point of disposal. Transfer is usually accomplished by consolidating refuse from several individual loads into one large load and then transporting that waste in a more efficient vehicle.

Transfer stations fall into a wide range of system sizes and complexity. After a review of the various types of transfer stations currently in use around the county, it was determined that two basic transfer station concepts are applicable to the Park County situation. These two concepts were then evaluated in detail. Included herein is a description of the two applicable concepts and the respective estimated costs of each.

(1) Transfer Station with Compaction

One alternative that was deemed potentially applicable was to replace the Park County landfill with a transfer station. For this option, the majority of the wastes generated in the landfill's current service area would be loaded into semi-trailers and transported to landfills located outside the county. The Group III materials would continue to be disposed of in the current county landfill.

In order to most cost effectively transport the county's waste to other landfill sites, it was determined that the wastes should be compacted into the transfer trailers rather than to be hauled uncompacted. A thorough review of the various transfer stations being used throughout the nation indicated that a push pit - stationary compactor transfer station arrangement would be most suitable for use in Park County. In a push pit arrangement, the station includes an enclosed receiving

TABLE 14

COMBINATION BALE FILL & CLASS III LANDFILL

1. CAPITAL COST

Same as conventional cost	$117,000	
Annual Cost - 8% - 34 yrs.		
(70% savings over conventional site)		$10,100

2. ANNUAL OPERATING AND MAINTENANCE COST

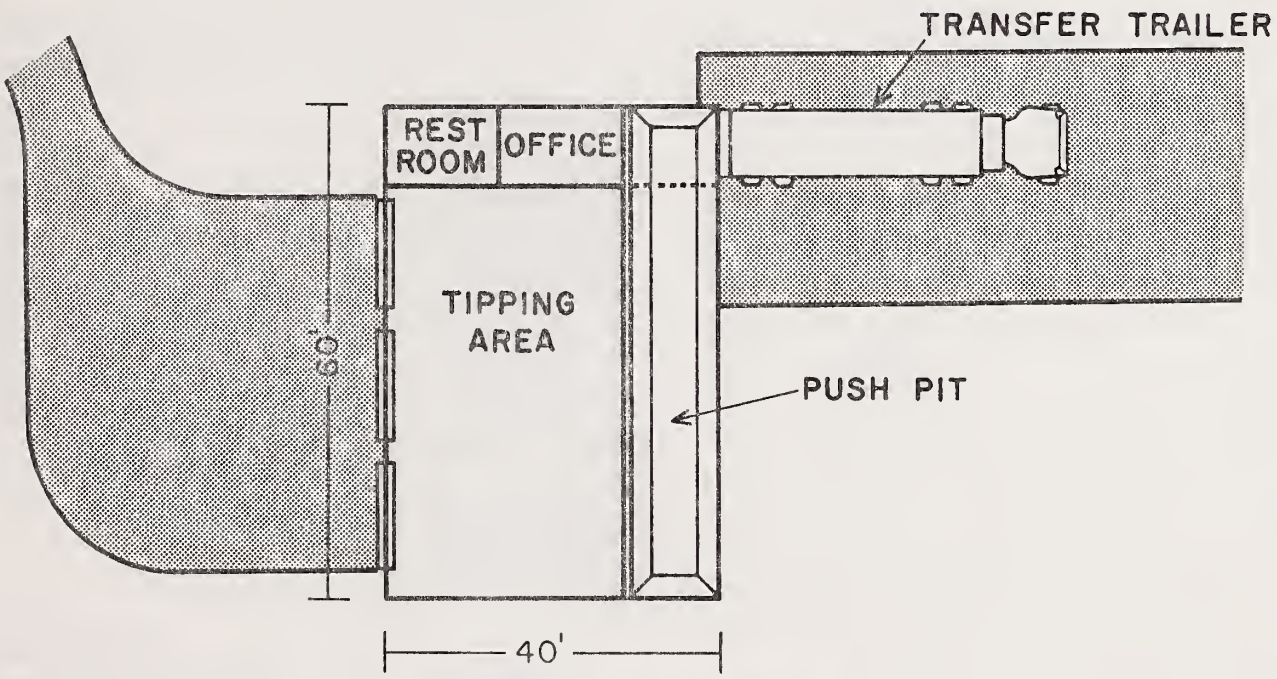
	Item	Units	Unit Cost	Annual Cost	
a)	Site & Road Maintenance	—	Lump Sum	$ 1,000	
b)	Equipment Depreciation, Operation & Maintenance (Front-end Loader)	520 hrs.	$25/hr.	13,000	
c)	Contract for Trench Excavation, etc.	—	Lump Sum	7,000	
d)	Insurance	—	Lump Sum	1,000	
e)	Labor (included in baling facility)			—	
		SUBTOTAL —		$22,000	$22,000
	TOTAL ANNUAL COST				$32,100

area where three vehicles can dump simultaneously, a large waste receiving and storage pit constructed of reinforced concrete, and a stationary compactor. In a push pit arrangement, the waste is initially deposited in a large pit. As the pit becomes full, a hydraulic ram pushes the waste to one end of the pit where a stationary compactor is located. The stationary compactor then forces the waste into a large transfer trailer. A schematic plan and elevation view of a typical push pit transfer station is depicted in Figure 7.

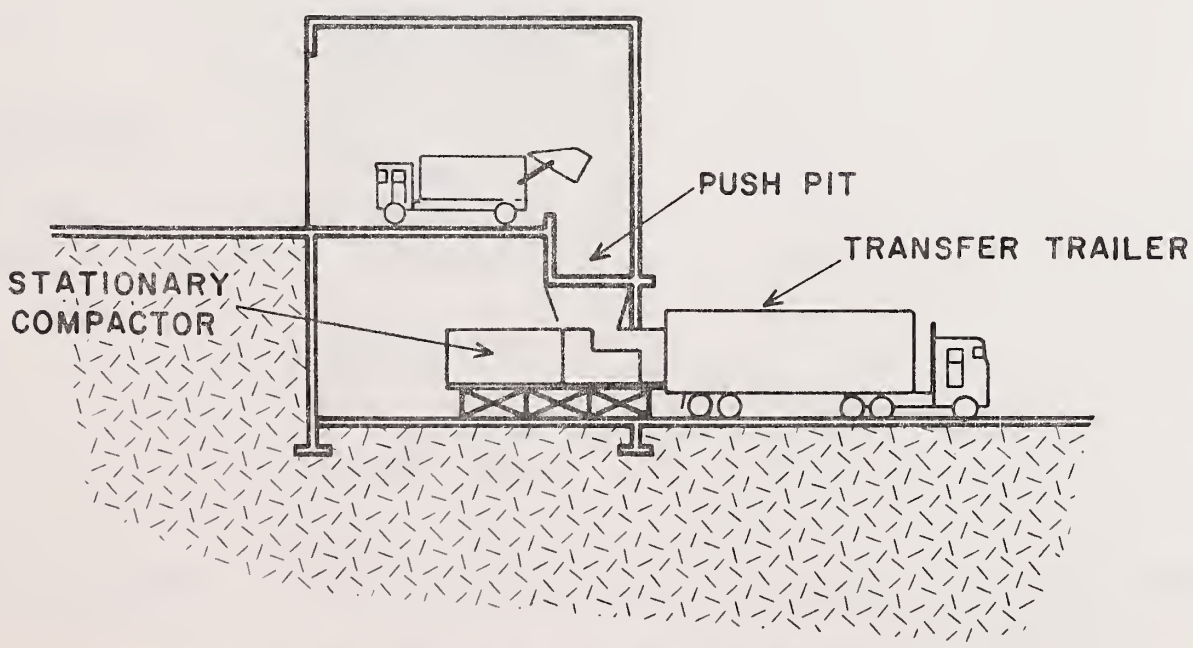
The capital and annual costs to construct and operate such a facility to meet the demands of Park County were estimated. The capital costs for this facility are summarized in Table 15a. As indicated, the estimated capital cost would be approximately $398,000. The annual cost to operate the facility is depicted in Table 15b. As indicated, the total annual cost to operate the facility, including amortization of the capital investment, is estimated to be $123,800. This is based on the facility operating five days per week.

In addition to the facility costs depicted above, the alternative of transferring wastes to another landfill would incur additional costs including transportation costs of the transfer trailer, a "drop charge" or user fee for the use of another city's or county's landfill, and the estimated cost to operate the current Park County landfill as a Class III disposal site. The transportation and drop charges associated with this transfer alternative are included and evaluated in the "Annual System Cost Analysis", which is summarized at the conclusion of this chapter. The estimated cost to operate the current landfill as a Class III site is depicted in Table 16. Basically, the state regulations do not require that Class III disposal sites provide daily cover as required for Class II landfills. Also, less stringent standards in regard to the location of Class II disposal sites are prevalent, due to the lessened potential for environmental and health hazards (pollution of groundwater and rodent problems) and generation of nuisance factors such as blowing paper, odors, and general aesthetic degradation. As depicted in Table 16, a full-time gate attendant to monitor dumping as well as the periodic use of a front-end loader was determined necessary to adequately maintain the site five days per week. As further depicted in the table, the amortization of the site improvements at the existing landfill would be negligible due to the fact that the in-place volume of waste that would enter the site when operated as a Class III landfill would be ten percent of the current volume of waste entering the site. Thus it is anticipated that the current landfill would last for approximately 200 years (ten times longer than under current conditions).

TRANSFER STATION FACILITY WITH COMPACTION



(SITE LAYOUT)



(ELEVATION VIEW)

Figure 7

TABLE 15a

TRANSFER STATION FACILITY
WITH COMPACTION
(Capital Cost)

Item	Unit Cost	Units	Total Cost
A. FACILITY COST			
1) Land	$4,000/acre	2.5 acres	$ 10,000
2) Sitework	Lump Sum	—	40,000
3) Building	$50/sq.ft.	60' x 40'	120,000
4) Scale	Lump Sum	—	20,000
5) Utilities	Lump Sum	—	20,000
6) Engineering, Legal & Contingency	Lump Sum	20%	42,000
	SUBTOTAL —		$252,000
	Amortization — (8% - 30 yrs.)		22,400
B. EQUIPMENT			
1) Push Pit & Compactor	$75,000	1	$ 75,000
2) Installation	20% of capital	—	15,000
3) Contingency	Lump Sum	10%	9,000
	SUBTOTAL —		$99,000
	Amortization — (8% - 15 yrs.)		11,600
C. ROLLING STOCK			
1) Bobcat	$10,000	1	$ 10,000
2) Transfer Trailer	33,000	1	33,000
3) Contingency	Lump Sum	10%	4,000
	SUBTOTAL —		$47,000
	Amortization — (8% - 5 yrs.)		11,800
TOTAL CAPITAL COST			$398,000
TOTAL AMORTIZED COST			$45,800

TABLE 15b

TRANSFER STATION FACILITY
WITH COMPACTION
(Annual Cost)

Item	Unit Cost	Units	Total Cost
1) Utilities	Lump Sum	—	$ 6,000
2) Insurance	Lump Sum	—	1,000
3) Equipment Maintenance	Lump Sum	—	15,000
4) Annual Supplies & Equipment	Lump Sum	—	3,000
5) Labor			
a) Supervisor	$16,000	1	16,000
b) Operator	$14,000	1	14,000
c) Laborer	$12,000	1	12,000
d) Scale Attendant	$10,000	1	10,000
6) Bobcat Operation & Maintenance	Lump Sum	—	1,000
	SUBTOTAL —		$78,000
	+ Amortization Cost —		45,800
TOTAL ANNUAL COST			$123,800

TABLE 16

CLASS III LANDFILL

1. CAPITAL COST

Same as Conventional Landfill	$117,000
Annual Cost - 200 yrs. (1000% savings over conventional site)	(negligible)

2. ANNUAL OPERATION & MAINTENANCE COST

	Item	Units	Unit Cost	Annual Cost
a)	Site & Road Maintenance	—	Lump Sum	$ 1,000
b)	Equipment Depreciation, Operation & Maintenance (Front-Loader)	400 hrs.	$25/hr.	10,000
c)	Contract for Trench Excavation, etc.	—	Lump Sum	2,000
d)	Insurance	—	Lump Sum	1,000
e)	Labor	1	$14,000	$14,000
	SUBTOTAL —			$28,000
	TOTAL ANNUAL COST			$28,000

(2) Transfer Station without Compaction

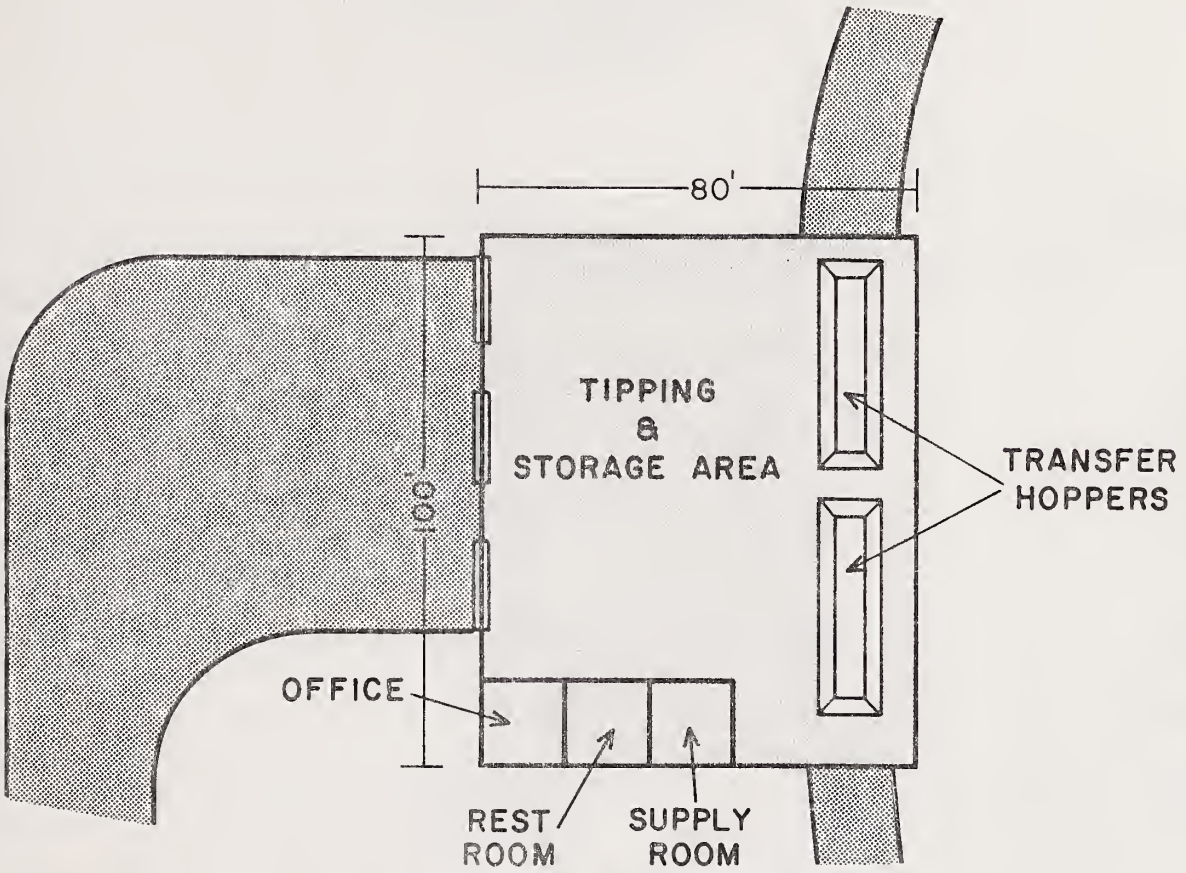
A second transfer concept determined potentially applicable was to construct a transfer station near the City of Livingston which would have the capability of storing up to three days' accumulation of waste generated in the county. When weather conditions would permit, the wastes would then be loaded into transfer trailers and hauled to the current county landfill site for disposal. As was the case for the alternatives discussed previously, the current landfill would also be open five days per week to accept Group III materials that would not be accepted at the transfer facility.

For this alternative, the transfer station would include an enclosed tipping and storage area and a transfer trailer loading area. At the facility the wastes would be dumped either directly into the open-top transfer trailers or onto the receiving floor. The wastes discharged onto the floor would be stacked and subsequently loaded into the trailers by a front-end loader. The transfer trailers utilized for this alternative would have a 75-cubic-yard capacity and would have the capability to achieve some compaction effect through the use of a ram plate mounted on the trailer. As previously stated, once the weather conditions permitted (wind subsides, etc.) the wastes placed into the transfer trailers would be hauled to the county landfill for disposal. Because the transfer trailers utilized at this facility would be similar to those currently being used by the National Park Service, it is anticipated that on windy days the Park Service could simply exchange a loaded transfer trailer for an empty one located at the facility. This would alleviate the need for designing the transfer station to accept large loads of waste and at the same time give the Park Service disposal service when extremely windy conditions prevail. A plan and elevation view of the proposed transfer station for this alternative are included in Figure 8.

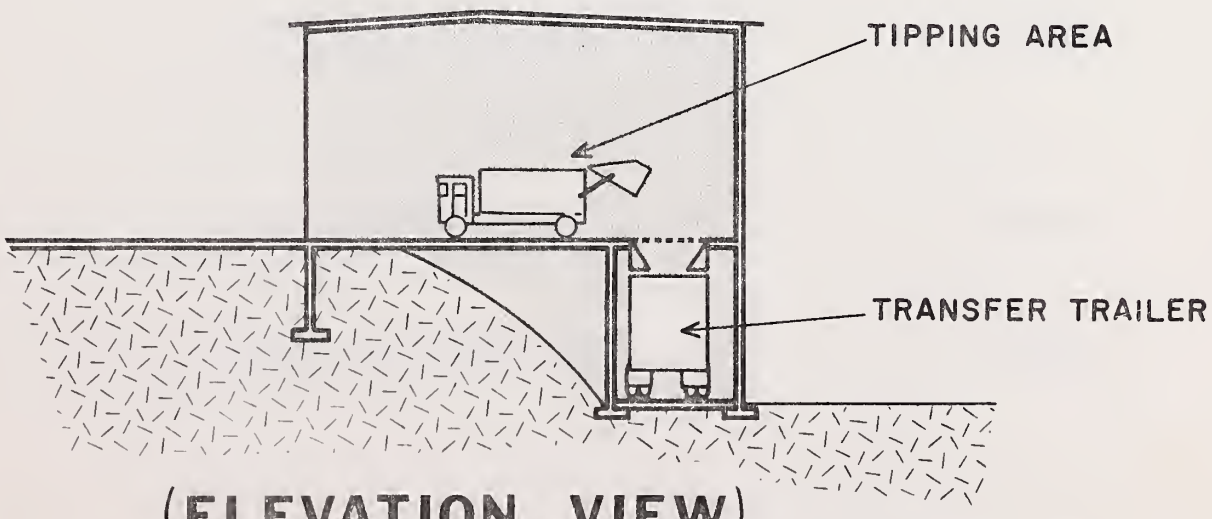
The capital and annual costs to construct and operate such a facility to meet the demands of Park County were estimated. The capital costs for this facility are summarized in Table 17a. As indicated, the estimated capital cost would be approximately $770,000. The annual costs to operate the facility are depicted in Table 17b. As indicated, the total annual cost to operate the facility, including amortization of the capital investment, is estimated to be $147,800. This is based on the facility operating five days per week.

In addition to the facility costs discussed above, the cost to operate the current landfill for these conditions must be addressed. The estimated cost to operate

TRANSFER STATION FACILITY WITH NO COMPACTION



(SITE LAYOUT)



(ELEVATION VIEW)

Figure 8

TABLE 17a

TRANSFER STATION FACILITY
WITH NO COMPACTION
(Capital Cost)

Item	Unit Cost	Units	Total Cost
A. FACILITY COST			
1) Land	$4000	2.5 acres	$ 10,000
2) Sitework	Lump Sum	—	40,000
3) Building	50/sq.ft.	80' x 100'	400,000
4) Scale	Lump Sum	—	20,000
5) Utilities	Lump Sum	—	15,000
6) Hoppers	$13,000	2	26,000
7) Engineering, Legal & Contingency	Lump Sum	20%	102,000
	SUBTOTAL —		$613,000
	Amortization — (8% - 30 yrs.)		54,500
B. ROLLING STOCK			
1) Front Loader	$35,000	1	$ 35,000
2) Transfer Trailer	$36,000	3	108,000
3) Contingency	Lump Sum	10%	14,000
	SUBTOTAL —		$157,000
	Amortization — (8% - 5 yrs.)		39,300
	TOTAL CAPITAL COST		$770,000
	TOTAL AMORTIZED COST		$93,800

TABLE 17b

TRANSFER STATION FACILITY
WITH NO COMPACTION
(Annual Cost)

Item	Unit Cost	Units	Total Cost
1) Utilities	Lump Sum	—	$ 3,000
2) Insurance	Lump Sum	—	1,000
3) General Supplies	Lump Sum	—	3,000
4) Labor			
a) Supervisor	$16,000	1	16,000
b) Front Loader Operator - Laborer	$14,000	1	14,000
c) Scale Attendant	$10,000	1	10,000
5) Front Loader	Lump Sum	—	7,000
	SUBTOTAL —		$54,000
	+ Amortization Cost —		93,800
	TOTAL ANNUAL COST		$147,800

the landfill in conjunction with the transfer station concept addressed herein is included in Table 18. It should be noted that the costs included in the table assume that one full-time attendant would be on duty at the landfill five days per week to supervise dumping and to operate the dozer to cover the waste. It was further assumed that the dozer would be operated approximately two hours each day, on the average, for each day the site was open. When comparing the annual cost to operate the county landfill under this system ($61,200/yr.) to the current landfill costs (see Table 11), it is estimated that the current landfill costs would be reduced approximately 50 percent. This is primarily because of the anticipated reduced equipment needs and on-site maintenance that would be required at the landfill site due to the reduced periods of time in which wastes would be brought to the site. (It is anticipated that all Group III wastes deposited at the landfill would be brought to the site at the end of each operating day, if the weather permitted.)

d) Waste Incineration with Heat Recovery

(1) General

Because of the increasing costs of fuel in the nation, alternative fuel sources are currently being developed and evaluated. Solid waste is receiving increasing consideration in this regard because it is available in substantial quantities and can be prepared for use as a fuel. One of the primary considerations in utilizing solid waste as an energy source is to locate or develop energy markets which fit other problem constraints. Those constraints are primarily: 1) the market must have an adequate fuel demand to make it economically worthwhile to install the necessary receiving and firing equipment; and 2) the market must have an agreeable attitude toward the utilization and pricing of a new energy source.

Through modern technology the utilization of solid waste as an energy source can be accomplished by three basic methods: 1) the use of solid waste as a primary fuel source to generate steam; 2) the use of processed solid waste as a supplemental fuel in combination with other fossil fuels; and 3) the use of gases derived from pyrolyzing solid waste. After a thorough review of the waste incineration and heat recovery systems in operation throughout the nation, it was determined that a modular incineration facility would be most applicable for the Park County situation. These types of systems do not require a high degree of initial waste processing, nor do they require large quantities of waste to be economically feasible. These systems are normally supplied in modules with current installations ranging in capacity from 10 to 250 tons per day. Included in the following section is a brief description

TABLE 18

CONVENTIONAL LANDFILL WITH USE OF
NON-COMPACTED TRANSFER STATION

1. CAPITAL COST

Same as Conventional Landfill (See Table 11)	$117,000
Amortization (8% - 20 years)	$11,900

2. ANNUAL OPERATION & MAINTENANCE COST

	Item	Units	Unit Cost	Annual Cost
a)	Site & Road Maintenance	—	Lump Sum	$ 1,000
b)	Equipment Depreciation, Operation & Maintenance (D-7 Dozer)	520 hrs.	$40/hr.	20,800
c)	Trench Excavation	—	Lump Sum	12,500
d)	Insurance	—	Lump Sum	1,000
e)	Labor	1	$14,000	14,000
		SUBTOTAL —		$49,300
		+ Amortization Cost —		11,900
		TOTAL ANNUAL COST —		$61,200

of the applicability of utilizing these modular incineration systems for the economical disposal of the wastes generated in the Park County area.

(2) Description of Applicable Incineration Facility

The modular incineration facility, which was described to be the most applicable type of waste-to-energy plant for use in Park County, was initially developed in the 1960's. Since this time, major modifications have been made. The systems that have been installed within the past few years have added heat recovery units and automatic ash removal systems. Basically, modular incineration systems consist of a primary combustion chamber, a secondary combustion chamber and a heat exchanger. The units are fed by a mechanical or hydraulic ram that charges the material onto a fixed bed. The waste is ignited by use of an auxiliary fuel until temperatures allow self-sustaining combustion. Combustion in the primary chamber is usually in a starved air atmosphere. An advantage of this is that a high particulate exhaust is not generated. The combustible gases generated in the primary chamber are completely combusted in the secondary chamber with the aid of auxiliary fuel. The hot gases are then passed through a fire tube or water tube boiler for heat exchange.

Currently there are five primary firms that market modular incineration systems. Included herein is a summary of each system's operating experience and system components.

i) Basic Environmental Engineering, Inc.

Basic incinerators utilize a three-stage incinerator. The corporation has had their greatest success utilizing an 85 percent alumina refractory, although other refractories have been used. The charging system is mechanically driven with a rack and pinion system. The firm primarily proposes the use of heat recovery equipment in the primary combustion chamber. According to Basic officials, the system is also designed to burn coal, wood and other solid fuels. The ash removal system consists of refractory line and doors that open and dump ash into a receiving bin.

Currently, Basic has eleven installation on-line, of which two are equipped with heat recovery equipment. The majority of these units are located in the Chicago area and are owned and operated by large firms.

ii) Clear Air, Inc.

Clear Air employs a three-chamber incinerator system whereby excess air is utilized. Because of this design, air pollution control devices are required. Firebrick is used in the primary chamber. A movable grate transfers the waste to the primary chamber. The movement of the grate transports the waste to the rear of the chamber where a conveyor moves the ash to a quench tank and hopper. The system's heat recovery system consists of a fire tube boiler.

Currently, Clear Air has two municipal incineration units on-line, each with a ten ton per day capacity. Neither unit utilizes heat recovery equipment. The company also has one industrial waste unit in operation.

iii) Comtro Division, Sunbeam Equipment Corp.

Comtro utilizes a starved air system in which waste is charged into the combustion chamber by a hydraulically operated ram. The company has utilized several fire tube boilers for heat recovery including those manufactured by Eclipse, Kiwaunee and ABCO. The ash handling system consists of a water sealed hopper with a conveyor that transports the ash to a disposal container.

Comtro currently has several incinerator systems in operation with capacities larger than ten tons per day. Three of these systems burn municipal waste, with twelve units utilized at industrial facilities. Approximately two-thirds of Comtro's installations utilize heat recovery equipment.

iv) Consumat Systems, Inc.

Consumat systems operate on a starved air principle in the primary combustion chamber. The flue gas is completely burned in the secondary incinerator chamber. The heat exchanger consists of a water tube boiler with fins placed in the unit to maximize recovery efficiencies. In more recent installations an automatic ash removal system has been included. With the system a ram ejects ash into a receiving hopper where it is quenched and displaced into a pit. The ash is then further conveyed to a disposal chamber.

Consumat has over 2,000 installations in operation throughout the world, 30 of which utilize heat recovery units. Several of the heat recovery installations have been in existence since the mid-1970's.

v) Kelley Company, Inc.

The Kelley system operates on a starved air principle. The waste is charged into the combustion chamber by use of a hydraulically driven ram. Kelley has utilized York-Shipley tube boilers for heat recovery in the past. The ash removal system for municipal applications consists of two rams positioned below the feed ram and a sliding door that accepts the ash into a water quenched chamber.

Currently, Kelley has eight municipal installations in operation, all of which are located in New Hampshire. None of these, however, includes the use of heat recovery equipment. Kelley has installed approximately 400 units throughout the nation, of which approximately five percent have heat recovery equipment.

vi) Summary

Based on the investigations made for this report, it was determined that at the present time the modular systems designed by Consumat Systems, Inc. appear to be the most technologically advanced and proven for the applications being considered herein. Thus cost estimates included herein are based on the installation of a Consumat system. It should be noted, however, that if a resource recovery system is implemented, a detailed investigation should be conducted that evaluates all prospective equipment suppliers and manufacturers.

The facility under consideration for this project would be rated at 75 tons per day with the capability to expand to 100 tons per day, and would consist of a single building that would house the tipping floor (dumping area) and the energy recovery equipment. The building would be ample in size to store 140 tons of waste (two days' storage). The receiving area would be designed so that private individuals as well as municipal and commercial refuse haulers could deposit their waste at the facility. A schematic floor plan of a proposed incineration facility of this type is depicted in Figure 9.

At the facility, solid waste would be dumped directly onto the tipping floor. The waste would then be moved, stacked and placed into the incinerator units by diesel operated wheel loaders. The refuse would be charged by a ram into one of

WASTE INCINERATION WITH HEAT RECOVERY

(SITE LAYOUT)

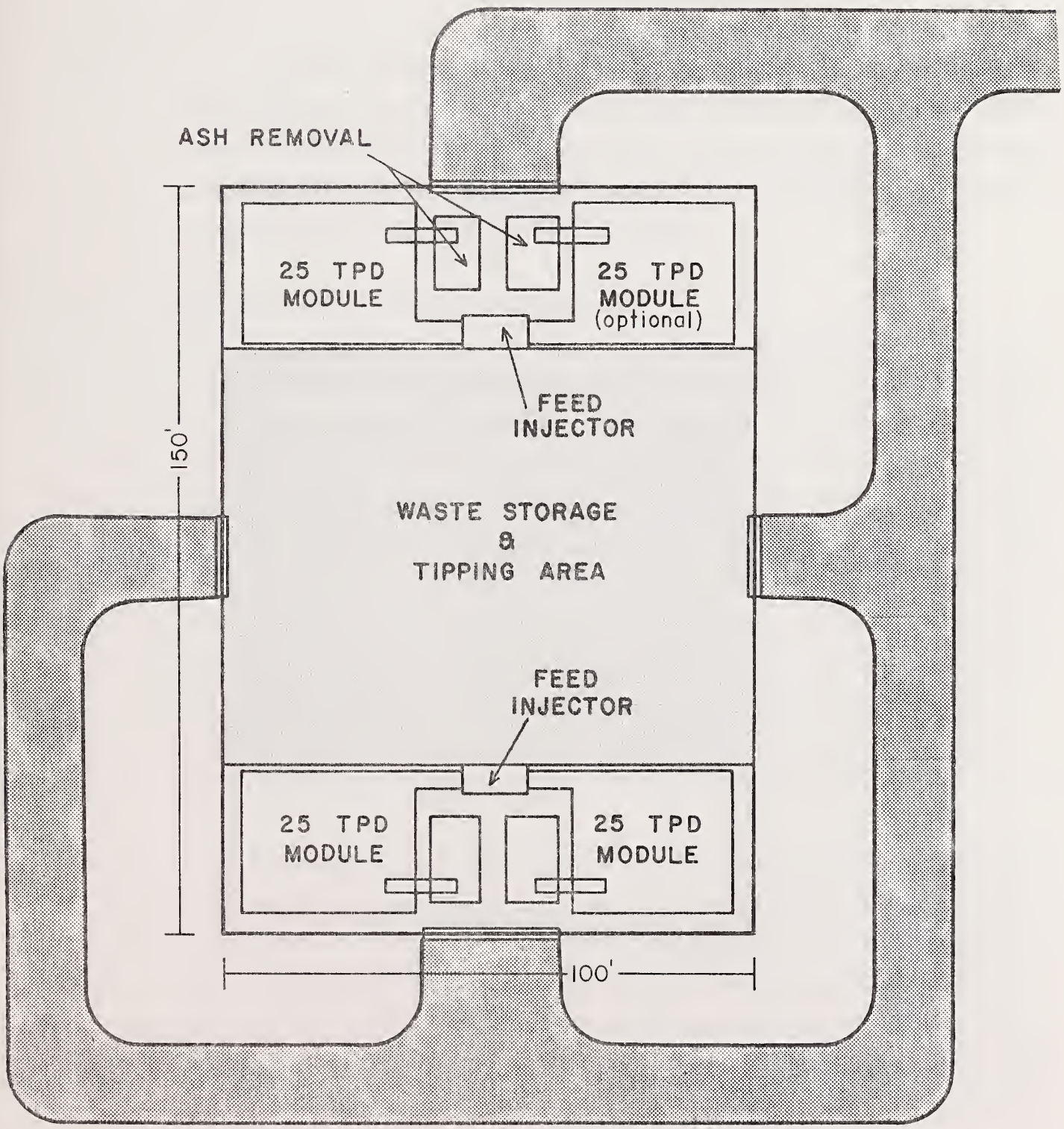


Figure 9

the three 25 ton per day incinerator units where it would be burned. The ash would be conveyed or dumped into roll-off containers located in the building. The ash would then be hauled to the Park County landfill for disposal. The existing landfill would remain operational to serve as a disposal site for incinerator ash, demolition debris and other non-combustible waste. It would also serve as a backup disposal site, should the energy recovery facility break down for any extended period of time.

The steam generated at the plant would be in a form such that it would meet the individual delivery conditions of the applicable energy user. A steam extraction turbine and generator would also be provided in order that electricity could be generated, which in turn could be sold to the local utility or be utilized to meet all or a portion of the energy user's electrical demands.

(3) Potential Energy from Solid Waste

As indicated in Table 4, there are currently approximately 14,000 tons of waste currently being disposed of at the Park County landfill. As further indicated in the table, approximately 90 percent, or 13,000 tons, of these wastes are considered Group II-type wastes which are basically comprised of residential and standard commercial wastes. Based on previous operating experiences throughout the nation, it can be assumed that all of these wastes would be compatible with standard waste incineration and heat recovery equipment. Thus for the situation as it currently exists in Park County, it was assumed that 13,000 tons of waste annually could be incinerated. It should be noted that for any waste-to-energy application, it would be necessary to continue the use of the Park County landfill to dispose of the remaining 1,400 tons of waste annually which would be comprised of demolition debris, inert materials and ash residue resulting from the incineration process.

Based on an average heating value of 5,000 Btu's per pound for solid waste, it is estimated that the 13,000 tons of waste incinerated annually could produce approximately $130,000 \times 10^6$ Btu's annually. This represents the energy equivalence of approximately 130 million cubic feet of natural gas annually. In regard to the generation of steam, it is estimated that the energy available from the same waste quantity would generate approximately 65 million pounds of steam annually, based on a generation of 125 psi steam at a 50 percent efficiency. Also, the same energy could produce approximately 3.9 million kwh of electricity.

As indicated in Figure 10, the availability of energy derived from the incineration of solid waste in Park County would fluctuate considerably, depending upon the generation of solid waste. As depicted, it is anticipated that the availability of energy would vary from a low of 4,240 lbs. of steam per hour during the month of December to a high of 12,500 lbs. per hour generated in August. This represents a seasonal fluctuation of approximately 300 percent from low to high.

(4) Market Analysis of Local Energy Users

For this project, the larger energy users in the county were contacted. Through each contact, it was attempted to determine if it was physically, economically and administratively feasible to utilize solid waste as an energy source at each facility. In addition to reviewing each user's fuel conversion equipment and facilities, market information relative to: 1) the quantity, quality and delivery conditions of the energy utilized; 2) the limitations and potential for expansion of the energy needs of the facility; and 3) the current market prices of the fuels utilized were obtained and evaluated.

Based on the investigations that were made, it was determined that the only current energy user in the area which has a large enough energy demand to utilize all or a majority of the energy available from burning solid waste is the Burlington Northern. Detailed information concerning the Burlington Northern's energy demands and their subsequent annual steam production costs were not made available. However, the information that was obtained indicated steam demands varying from 5,000 to 40,000 lbs. per hour, depending upon the season. Currently the Burlington Northern utilizes natural gas-fired boilers to produce their steam requirements.

In addition to the Burlington Northern, other possible existing market applications in the county were identified and evaluated. These included providing steam to Brand S Lumber, heating the Park County High School, and providing steam to heat the Central Business building. A review of these applications, however, indicated an extremely deficient energy demand to economically utilize solid waste as an energy source.

In regard to potential market applications that could be developed for utilizing solid waste as an energy source, three situations were discussed. These include: 1) providing the energy requirements for a gasohol plant to be constructed in the Livingston area; 2) providing steam from a central facility to heat and cool various

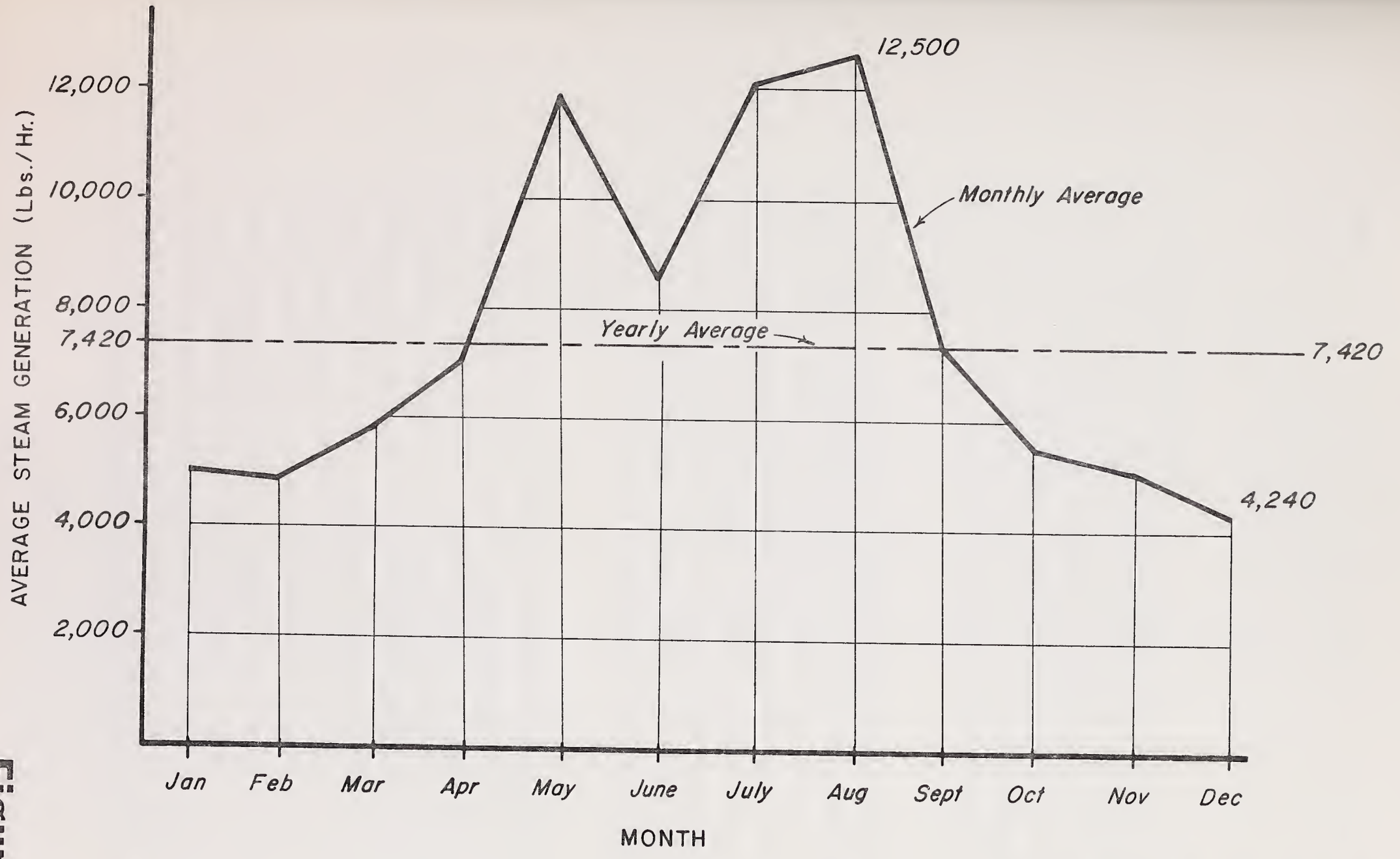


Figure 10

AVAILABLE ENERGY SUPPLY
FROM SOLID WASTE

facilities located at a potential industrial park complex; and 3) the generation and marketing of electricity for distribution into the Montana Power Company's existing grid. The potential economic feasibilities of these alternatives were investigated and are included in the "Annual System Cost Analysis" section of this chapter.

(5) Facility Costs and Analysis

To evaluate the economic feasibility of utilizing solid waste as an energy source in Park County, the Consultant drew on the expertise and knowledge of several individuals. Some of the individuals who provided input included City of Livingston and Park County officials, local engineers and businessmen, and equipment suppliers and manufacturers. Also, the Consultant visited installations currently in existence in the country that are demonstrating a similar application to that being considered herein.

Based on the information that was obtained during the analysis period of the project, capital and annual system costs were developed for the facilities being considered. Included in Table 19a is the estimated capital cost to construct a 75 ton per day modular incinerator plant capable of disposing of the wastes currently being brought to the Park County landfill. As indicated in the table, the total capital cost would be approximately $2.1 million. It should be noted that the costs depicted in Table 19a do not include the construction of steam lines or any "in-house" modifications that may be necessary to effectively utilize the energy generated from the system.

Included in Table 19b is a summary of the estimated annual cost to operate the proposed waste-to-energy incineration facility. Obviously, the precise cost to operate the necessary equipment would vary somewhat, depending upon the market application implemented. However, it is felt that this cost difference would not significantly affect the outcome of the economic cost analysis included herein. It should be noted that the labor costs included herein were based on the assumption that the facility would accept waste eight hours per day and would incinerate the wastes 24 hours per day for seven days each week. All other cost components were estimated based on conversations with equipment manufacturers, past operating records of similar installations, and current local insurance and utility costs. Also, it should be noted that in addition to the annual cost to amortize and operate the modular incinerator facility, the cost to maintain the Park County landfill five days per week as a demolition debris (Class III) landfill was included in the cost estimate

TABLE 19a

WASTE INCINERATION FACILITY
WITH HEAT RECOVERY
(Capital Cost)

Item	Unit Cost	Units	Total Cost
A. FACILITY COST			
1) Land	$4,000/acre	2.5 acres	$ 10,000
2) Sitework	Lump Sum	—	25,000
3) Building	$40/sq.ft	150' x 100'	600,000
4) Scale	Lump Sum	—	20,000
5) Utilities	Lump Sum	—	20,000
6) Engineering, Legal & Contingency	Lump Sum	20%	135,000
		SUBTOTAL —	$810,000
		Amortization — (8% - 30 yrs.)	72,000
B. EQUIPMENT COST			
1) Incineration Modules with Heat Recovery Package (25 TPD Modules)	$275,000	3	$825,000
2) Electrical Generation Equip.	Lump Sum	1	240,000
3) Installation	Lump Sum	20%	213,000
		SUBTOTAL —	$1,278,000
		Amortization — (8% - 15 yrs.)	164,000
C. ROLLING STOCK			
1) Bobcat	$10,000	1	$ 10,000
2) Dump Truck	$15,000	1	15,000
3) Fork Lift	$15,000	1	15,000
		SUBTOTAL —	$40,000
		Amortization — (8% - 5 yrs)	10,000
		TOTAL CAPITAL COST	$2,128,000
		TOTAL AMORTIZED COST	$246,000

TABLE 19b

WASTE INCINERATION FACILITY
WITH HEAT RECOVERY
(Annual Cost)

Item	Unit Cost	Units	Total Cost
1) Utilities	Lump Sum	—	$ 15,000
2) Insurance	Lump Sum	—	3,500
3) Incineration Units	Lump Sum	10% capital	82,500
4) Fuel Gas	$1.00/ton	13,000 tons	13,000
5) General Supplies	Lump Sum	—	3,000
6) Labor			
a) Supervisor	$20,000	1	20,000
b) Equipment Operator	$15,000	5	75,000
c) Laborer	$12,000	3	36,000
d) Front Loder Operator	$14,000	2	28,000
e) Scale Attendant	$10,000	1	10,000
7) Rolling Stock	Lump Sum	—	15,000
		SUBTOTAL —	$301,000
		+ Amortization Costs	246,000
		TOTAL ANNUAL COST	$547,000

for each application. As depicted in Table 19b, it is estimated that the annual cost to operate a modular incineration facility capable of meeting the waste disposal requirements for the area would be approximately $547,000.

C. ANNUAL SYSTEM COST ANALYSIS

1. General

The primary purpose of this section of the report is to evaluate and compare the annual system cost for each of the specific solid waste handling alternatives that were determined applicable for the county. As previously discussed in this chapter, there were three basic waste handling alternatives that were determined applicable and thus were evaluated in-depth. These included: 1) solid waste baling; 2) use of transfer stations; and 3) incineration with heat recovery.

For the basic alternatives that were identified as being applicable and thus warranting an in-depth analysis, initially specific disposal options were identified. Detailed studies and subsequent annual costs were then calculated for each option. Finally, the various cost components were individually added to determine each option's total system cost. These system costs were then compared with one another as well as with the current waste disposal costs so that the local officials and concerned citizens in the county could make general conclusions and subsequently make recommendations as to the most economical and practical waste disposal alternative for the county.

2. System Cost Components

For each specific solid waste handling option that was evaluated, it was determined that three basic cost components were applicable. These cost components included: 1) the individual waste handling facility capital and annual costs; 2) the disposal costs associated with operating the necessary sanitary landfill sites; and 3) the transportation costs associated with hauling the wastes from the various waste handling facilities to the final disposal site(s). Included herein is a brief discussion of each:

a) Waste Handling and Final Disposal Facility Costs

The costs associated with the construction and operation of the various waste handling facilities as well as the final disposal sites for each alternative were described and calculated indetail in Section B of this chapter. Thus, for each specific alternative that was evaluated herein, the waste handling and disposal costs included in Section B were utilized.

b) Transportation Costs

When evaluating the transportation costs of solid waste disposal systems, there are two types of haul that warrant consideration. These are: 1) primary haul, which represents the cost of transporting waste directly from the point of generation to either a rural container site, transfer station, processing plant or ultimate disposal facility; and 2) secondary haul, which represents the cost of transporting waste from one facility to another.

In most instances the primary hauling of solid waste is associated with the use of vehicles which initially collect or transport the waste. For wastes generated in urban areas, a packer-type collection vehicle is most generally used. For wastes generated in rural areas, the primary haul is usually associated with individuals transporting their wastes to either a disposal site or container site utilizing their own vehicles. When analyzing the secondary hauling of wastes, vehicles specifically designed to transport large quantities over long distances are utilized. These vehicles usually include either flatbeds, large transfer trailers or oversized compaction trucks.

It is the intent of the scope of services for this project to specifically determine and include in the system cost analysis only the secondary haul costs associated with each alternative evaluated. The reasoning behind not including specific primary haul costs in the system cost analysis is two-fold: 1) the intent of the project is to determine the most cost-effective method to dispose of the wastes generated in the county, which excludes door-to-door collection and individual transportation of wastes from each home or business to a central disposal site; and 2) it would be impossible to estimate the cost for each individual within the county to transport his or her own wastes to the various disposal sites which were evaluated.

In regard to estimating the secondary haul costs associated with each alternative that was evaluated for the county, unit haul costs were developed for three vehicle types. The sources of information used to derive the unit costs were: 1) equipment manufacturers and suppliers 2) operating records from city, county and private firms presently operating solid waste collection, transportation and/or disposal practices; and 3) an analysis of present labor rates and fuel prices throughout the county.

Table 20 summarizes the unit costs for the vehicles that were deemed necessary to transport the wastes for the solid waste handling systems determined

TABLE 20

TRANSPORTATION UNIT COSTS

1. DEPRECIATION

Vehicle Type	New Price	Less Salvage Value[1]	Est. Mileage	Cost Per Mile
a) Bale Transport	$58,000	$ 9,000	200,000	$0.25
b) Compacted Transport	73,000	11,000	200,000	0.31
c) Non-compacted Transport	70,000	10,500	200,000	0.30

(1) Represents 15% of new vehicle price

2. OPERATION AND MAINTENANCE

(Assume all vehicle types are similar)

a) Fuel Cost ($1.20/gal. – 4 mpg)	$0.30/mile
b) Oil and Lubrication	0.06/mile
c) Maintenance and Tires	0.55/mile
d) Insurance	0.13/mile
SUBTOTAL –	$1.04/mile

TOTAL COST

Vehicle Type	Depreciation	Operation & Maint.	Total
a) Bale Transport	0.25	1.04	$1.29/mile
b) Compacted Transport	0.31	1.04	1.35/mile
c) Non-compacted Transport	0.30	1.04	1.34/mile

applicable and thus warranting an in-depth analysis. As depicted in the table, the cost to operate the three vehicle types varies from $1.29 to $1.34 per mile. It should be noted that no labor costs are included in these costs. The labor costs to operate the transfer vehicles were calculated separately for each option. It should also be noted that the costs depicted in the table represent costs as of January, 1980 with no inflationary factors added. Also, it was assumed that the vehicles would be owned and operated by a non-taxable entity. Thus no overhead, taxes and profit were added to these vehicle costs.

3. System Cost Analysis Summary

Included in the following narrative is a summary of annual system cost analyses that were conducted for the specific disposal options determined potentially applicable for the county. The estimated annual system cost for each alternative is summarized in Table 21. As depicted in the table, the system costs are broken down by cost component for each alternative evaluated. The detailed cost breakdown for the handling facility and disposal facility cost components are included in Section B of this chapter. The estimated transportation cost components for each alternative were calculated according to the information contained in Table 22.

As summarized in Table 21, the currrent annual budgeted cost to operate the Park County landfill is $138,040. For the purposes of this study, all system costs for the other waste handling alternatives evaluated herein were compared to this cost, since any increased or decreased cost associated with the other alternatives will directly affect the local taxpayers' fees the same proportionate amount. Included herein is a summary of the alternate waste handling facilities that were evaluated for this project.

a) Solid Waste Baling

This basic waste handling alternative includes the construction of a solid waste baling facility whereby the wastes generated in the current waste disposal service area would be compressed into wire-tied bales weighing approximately 2,400 lbs. each. The baled wastes would be transported to and disposed of at the current county landfill site. The county landfill would also be utilized to dispose of the demolition debris and other wastes which would not be compatible with the baling facility.

For this basic baling alternative, two disposal options were evaluated: 1) locating the baling facility adjacent to the current landfill and transporting the bales to the landfill by forklift; and 2) locating the baling facility near the City of Livingston and

TABLE 21

PARK COUNTY SOLID WASTE
ALTERNATIVE ANALYSIS SUMMARY

Cost Component	Existing Landfill	Alternative						
		Baling		Compacted		Non-Compacted		
		Near Landfill	Near Livingston	Bozeman	Logan	Near Landfill	Near Livingston	Modular Incinerator
1. Handling Facility Cost	–	$211,000	$223,400	$123,800	$123,800	$147,800	$147,800	$547,000
2. Disposal Cost								
a) Site Depr., Op. & Maint.	$138,040	32,100	32,100	28,000	28,000	61,200	61,200	28,000
b) Drop Charge	–	–	–	79,000[1]	111,000[2]	–	–	–
3. Transportation Cost								
a) Vehicle Depr., Op. & Maint.	–	5,000	12,700	66,700	146,700	4,700	23,600	Included
b) Labor	–	Included	Included	14,000	28,000	Included	Included	Included
TOTAL ANNUAL COST	$138,040	$248,100	$268,200	$311,500	$437,500	$213,700	$232,600	$575,000
Percent Increase Compared to Existing Condition	–	80%	94%	126%	217%	55%	69%	316%

[1] Based on $5 per ton fee

[2] Based on $7 per ton fee

TABLE 22

TRANSPORTATION COST SUMMARY

Alternative	Miles/Trip	Tons/Trip	Trips/Year[1]	Miles/Year	Cost/Mile	Cost/Year
a) Short Haul - Bale			(Additional Cost for Forklift)			$ 5,000
b) Long Haul - Bale (Livingston to Existing Site)	10	16	988	9,880	$1.29	12,700
c) Transfer Station (Compacted)						
1) To Bozeman	50	16	988	49,400	1.35	66,700
2) To Logan	110	16	988	108,680	1.35	146,700
d) Transfer Station (Non-Compacted)						
1) Short Haul	2	9	1,760	3,520	1.34	4,700
2) Long Haul	10	9	1,760	17,600	1.34	23,600

(1) Based on 15,800 tons/year (projected average quantity of waste for next 20-year period).

transporting the baled wastes to the County landfill by use of a flatbed truck-trailer arrangement. The system costs for these two options are summarized in Table 21. A detailed cost breakdown of the various cost components is included in Tables 12, 13, 14 and 22. As indicated in the table, the net annual system costs of the alternatives would vary from $248,100 to $268,200, depending upon where the facility would be located. As further depicted in the table, it is estimated that the implementation of this alternative would represent an 80 to 94 percent increase in cost when compared to the costs associated with the current landfill operation. It should also be noted that the estimated capital cost of this alternative would be approximately $865,000 to $965,000, depending upon the baling facility's location.

(b) Transfer Station

For this basic alternative, it was determined that two specific transfer concepts were applicable and thus warranted a detailed analysis. One concept involves the use of a transfer station located near Livingston. This transfer station would have the capability of compacting the wastes brought to the facility into large 75-cubic-yard transfer trailers by use of a pushpit and stationary compactor. The compacted wastes would then be transported to a landfill located outside the county. For this option it was determined that two final disposal sites were potentially applicable. Thus the annual system cost for transporting the wastes to each were estimated. Under this option, the existing County landfill would continue to be utilized for disposal of the demolition debris.

The second transfer station alternative that was determined applicable was the use of an enclosed facility that would have the capability to store up to a three days' accumulation of refuse. For this alternative the wastes would be transported from the facility to the current County landfill by use of 75-cubic-yard transfer trailers when wind conditions and weather conditions were adequate to allow for disposing of and burying wastes. However, when extremely windy conditions were evident at the landfill site, the wastes would be stored at the facility until weather conditions improved. Also, under this alternative the demolition debris and inert materials would be directly disposed of at the current County landfill.

For this alternative, two alternate locations for the transfer station were evaluated; these being either adjacent to the current County landfill or near the City of Livingston. The estimated annual system cost for these two disposal options is depicted in Table 21. As illustrated in the table, the annual costs vary from $213,700 to $232,600, depending upon the location of the transfer facility. It is further illustrated that the costs associated with these options are 55 to 69 percent higher than current budgeted landfill costs. It

should be noted that detailed breakdowns of the costs associated with this option are included in Tables 17, 18, and 22. As depicted in Table 17a, the estimated capital expenditure to implement this alternative would be approximately $770,000.

(c) Incineration with Heat Recovery

This waste handling alternative includes the construction of a solid waste incineration facility whereby the wastes generated in the area would be burned in one of three modular incinerator units, each with the capacity of burning 25 tons of waste per day. The facility would have the equipment capable of extracting the steam from the combustion of the waste. The steam could then either be marketed to a local energy user or be utilized to generate electricity which could in turn be marketed. For this alternative the County landfill would continue to be utilized for the disposal of demolition debris along with the resultant ash and residue generated from the incineration process.

The annual system cost for this alternative is depicted in Table 21. Detailed breakdowns of these costs are shown in Tables 16 and 19. As indicated in Table 21, the annual system cost for this alternative is $575,000. This represents a 316 percent increase in annual fees compared to the current landfilling costs. It should be noted, however, that the annual cost depicted in Table 21 does not include any revenue associated with the generation of steam from the incineration of the wastes. As discussed in a previous section of this chapter, the wastes currently being disposed of at the Park County landfill have a heating value of approximately 130,000 million Btu's. This heat has the capability to produce approximately 65 million lbs. of steam per year.

Since the annual costs that are indicated in Table 21 for this alternative are extremely high, it is quite apparent that revenues from the sale of the energy generated from the incineration of the wastes must be obtained to make this option economical. Illustrated in the table below is the estimated revenues that would be required in order for this incineration option to be cost-competitive with the other waste disposal alternatives that were reviewed and included in Table 21. As depicted in the table, the estimated revenues are indicated for the two alternate forms in which energy is usually utilized and marketed; 1)steam and 2) electricity.

Energy Unit	Estimated Marketable Units	Current Landfill	Baling	Compacted Trans. Stat.	Non-Compacted Trans. Station
1. Steam[1]	65,000 x 10^3lbs.	$6.72/1000 lbs.	$5.03/1000 lbs.	$4.05/1000 lbs.	$5.56/1000 lbs.
2. Electricity	3,900,000 kwh	$0.11/kwh	$0.08/kwh	$0.07/kwh	$0.09/kwh

[1] Based on steam generated at 125 psi.

As depicted in the previous table, the revenues that would be required to make this waste incineration alternative cost-competitive with the other waste handling alternatives would vary from $4.05 to $6.72 per thousand pounds if steam were to be marketed, and $0.07 to $0.11 per kwh if electricity were to be marketed. It should be noted that these costs are based on the assumption that all available energy produced from the wastes currently being disposed of at the Park County landfill would be marketed.

A review of current energy prices in the Livingston area indicates that the price of steam varies tremendously, depending upon the energy users. However, based on a current natural gas cost of $3.25 per MCF, it would cost a local user approximately $4.00 in fuel costs to generate 1,000 pounds of steam if generated at comparable delivery conditions (pressure and temperature) to those utilized to calculate the costs depicted herein. Based on this price, it is felt by the Consultant that the generation of steam from solid waste in a facility such as that discussed herein would be cost-competitive with current natural gas-fired steam systems if all the energy could be marketed. Obviously, if all the available steam could not be marketed, the cost for the steam would increase a proportionate amount. In regard to the generation of electricity, it is apparent that the cost to generate solely electricity from a waste incineration facility is not competitive with current Montana Power rates in the Livingston area. From the analysis conducted herein, a minimum cost to generate electricity and be competitive with the least-cost alternative as depicted in Table 21 would be approximately $0.07 per kwh. According to current estimates, newly developed electrical generation costs are in the $0.04 to $0.05 per kwh range.

One additional option that was discussed during this study was the possibility of providing the necessary steam requirements for an ethanol facility located in the Livingston area from a waste incineration plant similar to that discussed herein. According to past experience, a low-pressure steam (10 to 15 psi) is required to provide the heating requirements of such a plant. Current information indicates that it requires approximately 50,000 Btu's to process one gallon of ethanol from such a facility. Based on this, it is estimated that the heating value available from the waste currently being disposed of at the Park County landfill would be sufficient to process approximately 2.6 million gallons of ethanol annually.

Since the ethanol process requires a low-pressure steam, it is anticipated that the high-pressure steam generated at a modular heat recovery incineration facility could initially pass through a turbine and generate electricity for marketing to the Montana Power Company. The resultant steam, after passing through the turbine, would then be acceptable to meet an ethanol facility's steam requirements. Summarized on the following page is the estimated

revenue which would be required from the sale of the electricity and low-pressure steam in order for this alternative to be cost-competitive with the current landfill alternative.

Item	Annual Cost
Estimated Incineration Facility Cost	$575,000
Less Possible Revenues:	
1) Current Landfill Costs	138,000
2) Sale of Electricity (3.9 million kwh @ $0.04/kwh)	156,000
Net Steam Production Cost	$281,000
Net Cost for Steam	$2.16/million Btu's

As depicted in the calculation summarized above, a net steam production cost of $2.16 per million Btu's of input fuel would be required in order that this alternative would be cost-competitive with current landfill costs. As depicted above, this unit energy cost is based on the assumption that the electricity produced from the incineration facility would be marketed for approximately $0.04 per kwh. At this time, it appears that the resultant energy cost of $2.16 per million Btu's is quite competitive with energy costs in the Livingston area.

PART FIVE

ANALYSIS OF SPECIAL WASTES

PART FIVE

ANALYSIS OF SPECIAL WASTES

A. GENERAL

The analysis included in the preceding chapter has primarily been devoted to the conventional solid wastes generated throughout Park County. These wastes are estimated to comprise approximately 90 percent of the total waste generated. As was discussed repeatedly in Chapter Four, however, regardless of the waste handling alternative that is implemented, alternative provisions and/or waste handling facilities must be made available for the remaining special type wastes which are incompatible with waste baling, transfer or incineration facilities.

Included in the following section of this report is a general evaluation of the existing disposal regulations, practices and concerns and the analysis of potential policies and procedures for properly disposing of those "special" type wastes which have given local officials problems for the past several years. Obviously, there are other types of wastes generated in the county that give local officials and residents occasional problems. However, in most cases these disposal problems are solved on a case-by-case basis and thus do not warrant an in-depth analysis at this time.

B. ANALYSIS OF INDIVIDUAL WASTE TYPES

In order to determine the proper disposal method for these "special" wastes, it was first necessary to classify them according to waste type. The federal government, through the Environmental Protection Agency (EPA), recently published waste classification and preliminary disposal guidelines throughout the nation. The EPA guidelines basically categorize solid waste into hazardous and non-hazardous wastes. Disposal criteria which are being developed for the various types of wastes by the EPA are in the draft stages and are currently being reviewed and finalized. The State of Montana generally classifies wastes according to guidelines established by the EPA. Under current State regulations all wastes categorized by the EPA as being hazardous are classified as Group I wastes. The current State standards require that all wastes classified as Group I materials must be disposed of in a Class 1 disposal site. The State requirements for operating a Class I site coincide quite closely with the standards which have been established by the EPA for a "Hazardous Waste Disposal Site". The State further classifies all decomposable wastes, excluding hazardous wastes, as Group II waste. State regulations require that these waste types be disposed

of in a conventional sanitary landfill, more commonly referred to as a Class II site. According to State regulations, all other materials such as construction debris, wood wastes and inert materials are classified as Group II materials and can be disposed of in a Class III disposal site (demolition and fill site).

Included in the following narrative is a summary of the information obtained and the conclusions and recommendations that were formulated for each type of waste analyzed.

1. Septic Tank Pumpings and Sludges:

(a) General

Significant quantities of septic tank pumpings are generated within the County annually. Septic tank systems are commonly used in much of the County due to the fact that municipal treatment services are not available in many of the smaller communities and no centralized services exist in most rural areas. In regard to sludge disposal, the treatment of industrial wastewaters and municipal sewage is responsible for the formation of most sludges. Currently, most industrial operations and municipal plants are responsible for the handling and disposal of their sludges.

In order to determine the proper disposal technique for these liquids and semi-liquids, it was first necessary to classify them according to waste type. According to the current EPA guidelines, septic tank pumpings are considered to be non-hazardous type wastes, and thus can be deposited in a conventional sanitary landfill. However, numerous types of sludges generated by industrial processes are included in the hazardous waste classification list and thus specific industries must comply ith the EPA hazardous waste guidelines.

In regard to the specific classification of septic tank pumpings and sludges, the State of Montana classifies these materials as Group II-type wastes with the exception of those industrial sludges which are classified as "hazardous" by the EPA. Unlike the majority of Group II-type wastes, however, the State regulations mandate that these type materials cannot be disposed of in a Class II disposal site without a special use permit to do so. The operational procedures and hydrogeologic conditions of each site must be evaluated individually and determined to be satisfactory before State approval to deposit these materials can be issued.

(b) Disposal Practices

(1) Septic Tank Pumpings

As previously mentioned, disposal of septic tank pumpings may occur at Class II landfills if state approval is granted. Currently, the Park County landfill has not been given authorization to be utilized for the disposal of septic tank pumpings. There is some evidence in the County that some septic tank pumpings are being indiscriminately dumped. This practice is not only unlawful, but quite hazardous due to the potential for groundwater pollution and public health problems.

(2) Sewage Sludges

The present published EPA regulations prohibit the disposal of raw sludge to landfills, or by other methods of land application such as spreading, spraying, or tilling. Under typical sewage treatment processes utilized today, approximately 95% of the sludge produced is water. To comply with EPA regulations some form of sludge concentration is required prior to disposal.

There are several common methods of sludge treatment and disposal in use at the present time. One method involves the addition of chemicals to condition the sludge before filtration to an intermediate concentration. This conditioned sludge produces a cake with a fairly high solids concentration. A second possible method involves the drying of sludge in evaporation beds. This requires the use of large areas of open surfaces and drying beds. Digested sludge is applied to the surface of the beds and excess water is filtered downward into a collection system. This process produces a relatively high solids concentration under proper conditions. Concentration of solids may also be accomplished by the drying and incineration of sludge in multiple hearth furnaces fired by oil, gas, or coal. Incineration of sludge results in the production of a totally dry ash which can then be disposed of. In most instances this conditioned sludge can then be disposed of in one of several ways, two of the more common being: 1) in an approved licensed landfill, and 2) on agricultural land for use as a soil conditioner.

(c) Recommendations

(1) Septic Tank Pumpings

Based upon conversations with state officials and the evaluation of the existing disposal guidelines and laws regarding disposal of septic tank pumpings, it is recommended that the following disposal methods be utilized.

a) Disposal of pumpings at one of the existing sewage treatment facilities in the area. In addition, the disposal of septic tank pumpings directly into wastewater treatment lagoons is an acceptable disposal method with no apparent ill effects on the wastewater treatment process.

b) Land spreading.

c) Drying in shallow evaporation ponds.

d) Proper disposal at licensed landfill sites.

(2) Sewage Sludges

As discussed herein the primary method of disposing of sewage sludges is in either an approved landfill site or on agricultural land for use as a fertilizer. Obviously, any sludge must be conditioned prior to its disposal utilizing one of the methods discussed herein.

2. Dead Animals

(a) General Disposal Practices

The number of dead animals, both domestic agricultural animals and game animals, varies throughout the year. Animal losses may occur during calving and lambing season when weather conditions are critical to many newborn animals. Hunting season also produces numerous instances of carcass abandonment. State law prohibits the placing of all or any part of a dead animal in any water body, road, street alley, lot, or field. It is also unlawful to place all or part of a dead animal within one mile of the residence of any person unless it is burned or buried at least two feet underground. Dead animals are classified as a Group II waste and may be disposed of at a Class II landfill if special procedures are taken. However, almost every county in the

state prohibits the burial of dead animals at sites within their respective counties.

Several methods of disposal currently practiced are in compliance with present state regulations. These include proper disposal on private land, disposal of the carcass at rendering plants and disposal at Class II landfills. Each of these techniques if properly administered will contain and restrict any of the potentially harmful constituents of the waste.

(b) Recommendations

Based upon conversations with state officials and examination of state regulations,the best method of carcass removal and disposal is by a rendering operation that is licensed and meets the Montana Department of Livestock requirements for rendering operations. In most instances the rendering service will provide free pickup and delivery if the number of animals and transportation distances are economical. Currently there are five rendering plants in the state which provide a disposal service for dead animals. The name, location and phone number for each are listed below:

NAME	LOCATION	TELEPHONE NO.
Billings Rendering Co.	Billings, MT.	248-8410
Dillon Rendering Co.	Dillon, MT	683-2812
Miles City Rendering Co.	Miles City, MT	232-1956
Rocky Mountain Rendering Co.	Great Falls, MT.	454-1953
Western Montana By-Products, Inc.	Missoula, MT.	543-8291

The second most desirable disposal method for dead animals is by individual owners on private property. This method in most instances is the least costly due to low transportation and handling costs. A third acceptable disposal method is at state approved sanitary landfills where proper handling procedures and supervision is adequate.

3. Bulky Materials

(a) General

Bulky wastes consist primarily of discarded appliances (white goods), demolition

debris materials (brick, rock, concrete, and wood wastes) and waste wood materials. According to state laws, these materials which are non-water soluble, inert solids are classified as Group III wastes. However, used appliances depending upon their constituents may be classified as Group II materials, and then must be disposed of at Class II landfills. The Group III materials may be disposed of at Class II or Class III sites.

(b) Existing Disposal Practices

As mentioned above, disposal of bulky materials may occur at Class II or Class III sites. At the present time, the majority of these type wastes are being transported to and disposed of at the Park County landfill. There are a few indiscriminate dumps located throughout the county where these wastes are being disposed of. However, the problem is not significant except during certain times of the year, when the local residents attempt to put these type wastes into the "green boxes".

(c) Recommendations

After examining the existing state laws regarding disposal of bulky materials, it is apparent that the majority of the existing disposal practices are in compliance with the laws. Of course, numerous instances of disposal occur that are in violation of state guidelines. One practice common at many landfills involves the burning of the combustible fraction of the bulky materials, primarily the wood wastes. Burning of any type is prohibited at any landfill. Indiscriminate dumping of materials is also prohibited by state law but will usually occur to a small extent.

The recommended disposal practices for bulky materials are as follows:

1. Proper disposal at a Class III (demolition debris) site
2. Disposal at a Class II disposal site
3. Salvage of the useable portion of the bulky materials (use of stone, brick, concrete and dirt for fill material is a good example).

4. Used Tires

(a) General

It is estimated that within the State of Montana approximately 680,000 used tires are generated as waste each year. This is based upon a national average of

1.14 waste tires per registered motor vehicle per year. This represents approximately 6,800 tons of tires assuming an average of 100 tires per ton. Over the past few years the composition of the tires manufactured has changed considerably. Synthetic rubber has replaced the use of natural rubber in the manufacturing of tires. The primary non-rubber components found in tires produced today are woven steel belting, fiberglass belting, polyester cord and steel bead wires. According to state laws, used vehicle tires are classified as Group III wastes and thus may be disposed of at Class II or Class III disposal sites.

(b) Alternate Disposal Methods

The most common practice of disposing of used tires within the County and the state consists of stockpiling or burying them in landfills or dumps. Unless properly placed in landfills, however, the tires will eventually work up to the surface. Because the majority of tires placed in landfills are not properly buried, the disposal of used tires has been a problem for many years.

Summarized in the following narrative are several alternative methods for used tire disposal which have been investigated and analyzed for application in the County. The majority of these alternatives are currently being used or have recently been used in various sections of the nation.

(1) Recapping

Information obtained from individuals associated with the recapping industry have indicated that only approximately 30% of the used tires casings disposed of are suitable for recapping. Several large companies collect used tires from local tire dealers and numerous small recapping plants operate within the state. Recapping partially solves the used tire disposal problem; however, there are many waste tires which are not capable of being recapped that must be dealt with.

(2) Preliminary Processing

Tires may be processed before disposal in order to eliminate problems associated with the handling and disposal. Another reason for preliminary processing relates to the potential recoverability of some or all of the constituents which comprise used tires. Processing may be accomplished by three methods; shredding, slicing and cryogenics. Shredding and slicing reduces the chances of tires working their way to the surface after burying. Also both processes substan-

tially reduce the volume of the tires which in turn reduce transportation and disposal costs. Shredding and/or slicing tires also prepares used tires in a physical form which is desirable for the reclamation of all or a portion of the tires constituents. Cryogenics is a special process whereby materials are subjected to sudden drops in temperatures. The process is based on the principle that embrittled materials will shatter easily. When applied to used tire disposal the net effect is similar to tire shredding. However, past study has indicated that this process is not feasible in Montana due to the small number of used tires generated annually.

(3) Recycling

Several applications have been investigated that may make it possible to reclaim significant quantities of rubber from used tires. Reclaimed rubber may be utilized as an additive to asphalt for paving. Considerable interest has also been shown for pyrolyzing tires. The pyrolysis process consists of heating shredded tire casings in the absence of air to a high temperature and breaking down the rubber into its original chemical constituents. Investigations have also been conducted to determine the feasibility of utilizing used tires as an energy source.

(4) Statewide Disposal Program

The State of Montana is currently investigating the feasibility of implementing a statewide tire disposal program. Based upon market investigations and other related studies completed by the state, it was determined that the initation of a statewide program is dependent upon locating a market outlet for the used tires. Recently, a Canadian firm has shown interest in obtaining large quantities of whole tires from the State of Montana for use as an additive to asphalt aggregate. Further study is currently under way to determine the economics and practicability of a statewide program.

(c) Recommendations

Based upon the investigation conducted for this report, it is recommended that tires be recycled by one of the methods discussed herein to the highest degree possible. If recycling of these tires is not economically attractive, these materials should be disposed of at the nearest state-approved sanitary landfill. Also, the possibility of implementing a state or regional recovery or disposal program should be continually evaluated and monitored. If such a program becomes feasible, each community should participate in the program to the maximum extent possible.

5. Scrap Automobiles

(a) General

Basically, a scrap automobile can be defined as a derelict, unused, inoperable automobile with little or no value. Based on national averages, it is estimated that the motor vehicle survival rate decreases from 95% surviving after 6 years in service to less than 20% after 14 years. During its "life cycle", a motor vehicle will pass from a transportation unit to a valuable source of materials, providing spare parts for other vehicles. Finally, the vehicle becomes a natural resource of scrap metals to be used by the metal making industries.

According to state law, abandoned automobiles are classified as a Group II waste, which may be disposed of at a Class II landfill. Due to the large amount of space required for storing junk vehicles at disposal sites and problems encountered with burial of the automobiles, many landfills, however, do not accept junk vehicles.

(b) Existing and Recommended Disposal Practices

A statewide junk vehicle disposal program was implemented in July, 1973. The program is financed by several sources: (1) the sale of junk vehicles; (2) a $0.50 fee levied on all vehicles registered in the state: (3) a licensing fee levied on all wrecking facilities and (4) a title transfer fee of $1.50. Under this program, funds are provided to counties for planning as well as operation. Each county may determine the type of program it feels best suits the needs of the citizens. The state provides assistance to each county as situations and problems arise. The program stipulates that each junk vehicle graveyard must have a minimum of two acres of land and be properly shielded from public view. After each graveyard has accumulated 200 vehicles a contract is obtained with a scrap dealer to dispose of the vehicles. The profit obtained from the vehicles is then placed in the state's operating budget.

At the present time there are 127 licensed motor vehicle wrecking facilities in the state. Since the program was initiated, these wrecking facilities have removed over 10,000 junked vehicles from the state. The majority of the vehicles are crushed and transported to one of various shredding plants located in the northwest. The shredded vehicles are then processed into scrap which in turn are transported to foundries to make new steel.

In summary, it is recommended that every attempt be made to dispose of a junk vehicle at properly licensed junk vehicle wrecking facilities or the County free motor vehicle graveyard site. This program has functioned quite effectively since its conception and is an economical and practical solution to a past waste disposal problem.

6. Hazardous Wastes

Many wastes produced by agriculture, industry, hospitals and certain governmental agencies may be hazardous and require that special precautions be taken during handling and disposal procedures. Problems with the disposal of hazardous wastes have been of major concern for the past several decades. Detrimental affects to public health and the environment may result if proper disposal of these materials does not occur.

A major problem with hazardous wastes has been the identification of what constitutes a hazardous waste. The Environmental Protection Agency (EPA) is responsible for identifying the hazardous wastes and recently released proposed guidelines and rules which are more comprehensive than any previously in effect. The proposed regulations attempt to define hazardous wastes and hazardous waste generators, as well as establish guidelines for proper transportation and disposal of the waste materials. The proposed EPA guidelines define "hazardous wastes" as : "A solid waste, or combination of solid wastes which, because of its quantity, concentration, or physical, chemical or infectious characteristics may: (a) cause or significantly contribute to an increase in mortality or an increase in serious illness; or (b) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported or disposed of or otherwise managed." (Federal Register, December 18, 1978.) The proposed guidelines and regulations established by the Environmental Protection Agency have also attempted to determine criteria for hazardous waste generators. According to the proposed guidelines, the EPA has tentatively determined that if an individual accumulates, produces or disposes of a waste classified by the EPA as hazardous at a rate greater than 1,000 kilograms/month (2,200 lbs/month), that individual is a generator. This standard does not apply to farmers and retailers. Disposal of 1,000 kilograms/month of hazardous waste according to EPA guidelines, may occur at an on-site or off-site facility provided the facility is approved by the state and included in a state solid waste management plan.

The EPA guidelines and rules provide the basis for the State of Montana's regulations regarding the hazardous wastes. According to the state's definition, hazardous wastes include, but are not limited to, "those which are toxic, radioactive, corrosive, flammable, irritants, or

which generate pressure through decomposition, heat or other means. The specific wastes which are hazardous wastes are those solid wastes classified by EPA's rules as hazardous wastes". (Section 16-2.14 (2) - S14100 - ARM., Solid Waste Management). It is evident from the above definition that the state is extremely dependent upon the EPA guidelines. The state has not yet established its own set of hazardous waste regulations; however, the state's regulations regarding identification, handling and disposal of hazardous waste will be formalized after the proposed EPA regulations have been finalized and adopted.

Several types of hazardous wastes exist within Park County. The following narrative identifies the existing and recommended disposal practices for the more commonly generated waste types.

(a) Pesticides and Containers

(1) General

Because of the agricultural nature of a considerable portion of the county, it is expected that a significant amount of excess pesticide and pesticide containers are generated within the area. Proper handling and disposal methods must be utilized in order to prevent detrimental effects on the environment and public health. According to state law, no person shall dispose of or receive for disposal any pesticide or pesticide container residue in a manner inconsistant with safe disposal criteria and procedures. It is also unlawful to dispose of these materials by burning or by dumping improperly.

(2) Alternate Disposal Methods

There are several acceptable methods by which excess pesticide may be disposed of without causing unreasonable adverse effects on the environment. The most preferred method of disposal is to return the excess material to the manufacturer, distributor or to another party capable of using the material. The alternate disposal method is burial at a disposal site that has been approved by the State or EPA.

Several procedures are recommended for the safe disposal of pesticide containers. Many combustible containers may be disposed of at Class I or Class II landfills depending upon the chemical constituents the containers held. Burial of many containers may also occur on farm premises. Precautions should be taken,

however, to avoid contamination of surface and groundwater. Non-combustible containers should be triple rinsed, following a procedure established by the Department of Agriculture, to dilute the hazardous material prior to disposal or transportation to a disposal facility. After the rinsing procedure, metal containers may be disposed of by: (1) returning the container to the dealer, (2) taking the container to a scrap metal dealer or junk vehicle graveyard which has obtained authorization by the state to recycle pesticide containers, (3) burial in a Class I or II sanitary landfill, or (4) burial on farm premises.

The Montana Department of Health and Environmental Sciences was involved in a waste pesticide management program from 1969 through the fall of 1978. The Health Department accepted highly toxic or other waste pesticides from state residents and transported them to storage bunkers located at the inactive Glasgow Air Force Base in northeastern Montana. Recently, the pesticides and pesticide containers were transported from the bunkers to a hazardous waste disposal site located near Boise, Idaho. The program was developed to provide safe storage and disposal for excess pesticides generated by pesticide users who would normally be faced with storage and disposal problems. The funds for this program have been exhausted and currently no additional grant monies are available to continue the program.

(3) Recommendations

Based on the research and analysis conducted for this project, it is recommended that all unused pesticides should be returned to the local dealers or transported to the nearest Class I site for disposal. These type materials should not be disposed of in Class II or Class III landfills, nor should they be disposed of on private property without approval from the appropriate state and local regulatory agencies. All pesticide containers should be triple rinsed prior to disposal. Rinsed containers should then either be transported to a local scrap dealer for reprocessing or buried at a Class II landfill.

(b) Used Lubrication Oils

(1) General

Based upon studies performed in other regions, it has been estimated that over two-thirds of the automobile lubrication oil sold results as a waste product

which is not salvaged or reclaimed. Used oils are generally disposed of in trash collections, on roadways to control dust, or placed directly in landfills. This oil, unless it is burned, does not disappear and may eventually find its way into groundwater sources and become a pollutant to water supplies. In the study area and state it is quite possible that as much as 90 to 95 percent of the used oils are being discarded rather than recycled. This is due primarily to the lack of available recycling plants and markets located within the state.

(2) Existing and Alternate Disposal Methods

a) Land Disposal

Presently, a common method of waste disposal in the County and state is by dumping oil on the ground or in ravines or coulees. This is the least desirable method of used oil disposal and should be avoided. If used oils are not properly reclaimed, they should be disposed of using sanitary landfill techniques which do not result in contamination or pollution of nearby aquifers or streams. An acceptable method of disposal of small quantities of used oils has been to mix the oil with other materials deposited in a sanitary landfill. Currently, the Burlington Northern generates a considerable volume of waste oils and sludges. Some of these products are recycled at their new facilities, with the remainder brought to the Park County landfill.

b) Re-Refining

After lubrication oil has been used over a period of time, contaminants such as gasoline, water, heat- and cold-resistant additives and dirt collect within the oil. The contaminants may be removed from the used oil by a re-refining process. The resultant product is a lubricating oil which is quite similar to the original product. At the present time, no re-refining facilities are available for the waste oils generated by private individuals within the State of Montana. Currently, the largest re-refining process in the state is located at the Burlington Northern's facilities in Livingston. This facility is limited, however, to those oils generated by the B.N. operations.

c) Other Reclamation Alternatives

Several other reclamation methods may be used to dispose of waste oils. These include incineration and use as a fuel source, use as road oil and use as

asphalt. Tests conducted by various industrial concerns have demonstrated that it is possible to recover some energy from several types of waste lubricants. The waste oils may also be used as a supplemental fuel for large boilers. An indirect method of disposing of waste oil is the use of oils for dust control. Although road oils have been and are still manufactured from virgin materials, a large amount of this material is comprised of waste oil. Some drain oil and distilled drain oil fractions may be used as cutting stock for producing asphalt. Most of the metallic compounds present in the oil are relatively insoluble and presumably coated with asphaltic materials. As a result, little rain leaching would be expected for asphalt uses. Each of these processes may result in some form of pollution and special precautions should be taken to minimize the detrimental effects on the environment.

d). Statewide Program

Several attempts have been made to establish a statewide waste oil recovery program. A statewide program is highly dependent on a developed market or outlet for the used materials. Curently, however, no used oil market is available in the state. Any major recycling program is dependent upon the policies established at the state and federal level. Until re-refined oil gains the Society of Automotive Engineers (SAE) seal of approval, it is doubtful that the use of re-refined oil will be widespread. The state and federal government currently discourages the use of re-refined oils in government owned vehicles because of current automobile manufacturer policies which void all warranties on vehicles that utilize non-SAE approved motor oils. Until some action is taken at the state and national level, it is unlikely that many states will establish a statewide program of using re-refined lubrication oils.

(3) Recommendations

Based on the analysis conducted herein it is apparent that no practical method for waste oil disposal is available to the residents in the County which meets all state and federal criteria. The "best" current alternative available is to dispose of these materials in small quantities at the Park County landfill or to set up storage tanks at strategic locations for use by the public with ultimate disposal at a major waste oil recycling depot. It is also recommended that the citizens in the County should encourage the use of any regional or statewide oil recovery program if one is implemented in the future.

PART SIX

SUMMARY AND RECOMMENDATIONS

PART SIX

SUMMARY AND RECOMMENDATIONS

A. PROJECT SUMMARY

As indicated in the initial chapter of this report, the primary purpose of this study was to identify and evaluate applicable solid waste handling and disposal alternatives that would satisfy the waste disposal requirements for the various jurisdictional entities currently utilizing the Park County landfill. Currently, the Park County landfill receives approximately 14,400 tons of waste annually, of which approximately 40 percent is generated in the City of Livingston, 24 percent is generated through a rural "green box" program administered by the County Refuse District, and 22 percent is generated in Yellowstone National Park, with the remaining 14 percent generated by and transported to the landfill by miscellaneous private concerns and industries located in the Livingston area.

As stated in Chapter Two, the current County landfill is operated and administered through the Park County Refuse Disposal District. Due to the extremely windy conditions that are prevalent in the area, the operation of the site without causing local litter problems was determined to be practically impossible. The local officials responsible for the site have utilized various operational strategies in an attempt to operate the site with minimal litter problems. Because all efforts have failed, the local officials retained the firm of Robert Peccia & Associates to evaluate alternate disposal methods. A detailed analysis of the alternatives that were determined applicable and thus were evaluated in detail is included in Chapter Four of this report. As a result of the analysis that was conducted for this study, the following conclusions can be made for the various alternatives.

1. Sanitary Landfill

It was determined by the local officials that no parcels of land which are suitable and conducive to sanitary landfill operations are available in close proximity to the centroid of the waste generation in the County. Most sites can be ruled out either due to extremely windy conditions, excessively permeable soils with high groundwater, or close proximity to residential areas. Based on these factors, the possibility of locating a new landfill in the County was ruled out as a possible alternate by the local officials during the initial stages of the study.

2. Baling Facility

For this study the alternative of constructing a solid waste baling facility located either near the City of Livingston or adjacent to the County landfill was evaluated. For the alternative,

the baled wastes as well as the demolition debris and other bulky materials that are not conducive to baling would be disposed of at the current County landfill site. The capital costs for this alternative were estimated to vary from $865,000 to $965,000. The annual operational costs for this alternative would be approximately $250,000, which would represent an 80 percent increase in costs compared to the current landfill operation.

In regard to baling solid waste, there are several advantages compared to the operation of a typical landfill disposal system. These include: 1) increased life of a disposal site due to higher in-place waste densities; 2) fewer landfill operational problems and lower costs; 3) lower waste transportation costs; and 4) increased potential for recycling due to the possibility of baling and thus reducing transportation costs of recoverable materials such as corrugated, white goods, ferrous metals. etc. The primary disadvantages of baling include: 1) high initial capital investment; 2) high operation and maintenance costs; and 3) reduced potential for implementing a waste-to-energy recovery program in the future.

3. Compacted Transfer Station

This alternative basically involves the use of a transfer station located near Livingston. This transfer station would have the capability of compacting the wastes brought to the facility into large 75-cubic-yard transfer trailers by use of a pushpit and stationary compactor. The compacted wastes would then be transported to either the City of Bozeman landfill or the privately operated site near Logan. The annual costs for this alternative would vary from $311,500 to $437,500, depending upon the landfill site used.

The primary advantages of this alternative would include: 1) the increased flexibility of where solid waste could be transported and consequently either disposed of or recycled; 2) the reduced potential burden and responsibility associated with the operation of a sanitary landfill which currently rests with the local officials. The major disadvantages for such a system include: 1) the decreased control which the local officials would have over establishing rates and guaranteeing disposal site access and availability; and 2) the potential high costs that may be incurred due to the ever-increasing cost of fuel to operate the transfer vehicles.

4. Non-Compacted Transfer Station

This transfer station alternative basically includes the use of an enclosed facility that would have the capability to store up to a three days' accumulation of refuse. For this alternative the wastes would be transported from the facility to the current County landfill by use of 75-cubic-yard transfer trailers when wind and weather conditions were such that disposing of and burying the waste was possible. However, when extremely windy conditions were evident

at the landfill site, the wastes would be stored at the facility until weather conditions improved. The annual cost for this alternative was estimated to be approximately $225,000 with an estimated capital cost of approximately $770,000. According to the economic evaluations conducted for this project, this basic alternative had the lowest annual system cost of all the alternatives investigated.

In addition to the lowest annual cost, the primary advantage of this alternative is the flexibility which is available in that once the wastes are loaded into the transfer trailers, the wastes could be hauled to any available waste disposal site. The basic disadvantage of this alternative is the continued need to operate and administer the existing County landfill as a Class II disposal site. Also, if excessive winds occured for periods exceeding three days, possible litter problems could arise. It is anticipated, however, that these operational problems would be substantially reduced when compared to the current operational procedures.

5. Incineration with Heat Recovery

This waste handling alternative includes the construction of a solid waste incineration facility whereby the wastes generated in the area would be burned in one of three modular incinerator units. The facility would have the equipment capable of extracting the steam from the combustion of the waste. The steam could then either be marketed to a local energy user or be utilized to generate electricity, which could in turn be sold to the local utility company.

According to the cost evaluations determined applicable for this alternative, it was determined that the annual system cost to operate a modular incineration system would be approximately $575,000. However, it was determined that if sufficient revenues could be obtained from the sale of the steam and/or electricity generated from the facility, then the annual cost of the alternative could be cost-competitive with the other disposal alternatives evaluated.

There are several advantages associated with this alternative. They include: 1) the replacement of non-renewable energy sources with a renewable energy source; 2) the potential for a long-term disposal solution, since the current landfill would last for approximately 80 to 100 years compared to a site life of only 20 years under the current disposal practices; and 3) the potential long-term economic benefits, since the waste recovery facility's annual costs would be directly related to the current and future energy costs. The major disadvantages of this alternative are: 1) the relatively unproven "track record" of the proposed incineration system due to the fact that facilities similar to these have only been in service for the past ten years or less; and 2) the potential for higher annual disposal costs that would be incurred if an energy user(s) with sufficient demand could not be found to purchase the available energy produced from the system.

B. RECOMMENDATIONS

Based on the evaluations and investigations that were made for this study and the input obtained from the local officials who were directly involved in the study, the following recommendations were made by the Consultant.

1. Existing Landfill

It is recommended that the current landfill not be utilized in the future as a Class II landfill due to the extremely windy conditions in the County. However, regardless of the alternate waste handling system implemented, it is recommended that the current site continue to be utilized as a Class III (demolition debris, etc.) site. It is further recommended that a gate attendant be on duty at the landfill site during all operating hours to control and supervise dumping.

2. Modular Incineration

It is recommended that the alternative of utilizing a modular incineraton facility be evaluated in more detail in the near future. The analysis should include a detailed market study of the potential energy users and options in the area as well as the finalization of the capital and annual system costs for the market situation(s) that indicate the highest potential feasibility. It is further recommended that no final decision as to the implementation of this alternative be made without obtaining firm commitments and contracts from the potential energy market(s). Also, it is recommended that firm commitments and contracts be obtained from the major waste generators in the area, including the City of Livingston and the National Park Service, as to their participation prior to making a final decision to implement this alternative.

3. Transfer Station

It is recommended that if a final feasibility study for the modular incineration alternative indicates that option to be unfeasible, either the compacted or non-compacted transfer station option should be seriously considered. As indicated herein, there are several advantages for each option. As indicated for the modular incineration alternative, it is recommended that the costs be finalized for the selected alternative prior to making any final decisions or commitment. It is also recommended that firm contracts from the major waste generators as well as the potential landfill owners in the area be obtained prior to making a final commitment for purchasing equipment, etc. for either of the transfer alternatives.

4. Baling

It is recommended that if the incineration and transfer station alternatives are not implemented, the baling option should be seriously considered.

5. Organizational Strategies

It is recommended that the Park County Refuse Disposal District continue to be the lead agency in implementing one of the alternatives evaluated herein. It is further recommended that the City of Livingston and the National Park Service be involved to the fullest extent possible and provide assistance and input during the upcoming decision-making process.

APPENDIX A

PARK COUNTY DISPOSAL RECORDS

TABLE A - 1

PARK COUNTY DISPOSAL RECORDS

	Density	August '78		Sept. '78		Oct. '78		Nov. '78		Dec. '78		Jan. '79		Feb. '79		March '79		April '79		May '79		June '79		July '79		Totals		
	lbs/CY³	CY³	Tons	CY³	Tons	CY³	Tons	CY³	Tons	CY³	Tons	CY³	Tons	CY³	Tons	CY³	Tons	CY³	Tons	CY³	Tons	CY³	Tons	CY³	Tons	CY³	Tons	%
City Trucks	475	2183	518.46	1681	399.24	1844	437.95	1858	441.28	1444	342.95	1707	405.41	1496	355.3	2069	491.39	1872	444.60	4477	1063.29	1876	445.55	1823	432.93	24330.0	5778.38	
County Individuals	150	.5	.04	20	1.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	37.5	2.81	58.0	4.35	
County Compactor	475	1610	382.38	1273	302.34	1055	250.56	820	194.75	720	171.00	1030	244.63	950	225.63	1005	238.69	1576	374.30	1620 1277	384.41	1306	310.18	1774	421.02	14766	3506.93	
Hillman	425	224	47.6	120	25.5	142	30.18	110	23.38	120	25.50	160	34.0	140	29.75	150	31.88	170	36.13	160	34.0	110	23.38	170	36.13	1776.00	377.40	
City Individuals	150	331.5	24.86	337	25.28	377	28.28	206.5	15.47	215	16.13	177	13.28	142.5	10.69	262	19.65	978.5	73.39	1169	87.68	846	63.45	394	28.80	5426.00	406.96	
B.N.R.	150	97.5	7.31	68.5	5.14	164	12.30	111	8.33	125	9.38	134.5	10.09	123.5	9.26	213.5	16.01	586	43.95	713	53.48	650	48.75	700	52.5	3696.5	277.24	
Subtotal		44465	980.65	3499.5	759.0	3582.0	759.21	3105.5	683.23	2624.0	569.96	3208.5	707.41	2952.0	630.63	3699.5	797.62	5182.5	972.37	8146.0	1624.86	4788	871.31	4908.5	979.28	50042.5	10350.51	
N.P.S.	475	3780	897.75	1573	373.59	375	89.06	375	89.06	295	70.06	390	92.63	285	67.69	380	90.25	285	67.69	655	155.56	1775	421.56	1375	326.56	13563	3221.21	
Subtotal		8226.5	1878.4	5072.5	1132.59	3957.0	848.33	3480.5	772.29	2919.0	635.02	3598.5	800.04	3137.0	698.32	4079.5	887.87	5467.5	1040.06	8801	1780.42	6563	1312.87	6283.5	1305.56	63605.5	13571.72	
Contractors	800	24	9.6	45	18.0	90	36.0	5	2.0	2	.8	90	36.0	157	62.8	270	108	197	78.8	350.5	140.2	500	200	362	144.8	3012.5	837.0	
Totals		8250.5	1888.0	5117.5	1150.59	4047.0	884.33	3485.5	774.29	2921.0	635.82	3688.5	836.04	3294.0	761.12	4349.5	995.87	5664.5	1118.86	9151.5	1920.62	7063	1512.87	6645.5	1450.36	66617.5	14408.72	